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ABSTRACT

Although there has been a number of teacher's guides for solid waste and recycling published, none have been specific to the state of Vermont or tailored to the needs of its teachers. This guide is designed to fill that need and is meant to give busy teachers a resource for integrating this important topic into their existing schedules and required courses. The guide is organized into four levels; grades K-3, 4-6, 7-8, and 9-12. Within each level, the activities are organized under three topics: (1) "What is Waste?," including origins, natural resources, and society; (2) "How Do We Manage Waste?," including waste handling and litter; and (3) "How Can We Reduce Waste?," including changing habits, recycling, and composting. An information section organized in the same manner as the activity section lists resources from the state of Vermont and national sources. Bibliographies for further readings are appended. (CW)

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AVR Teacher's Resource Guide for Solid Waste and Recycling Education

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Susan Pedicord

Association of Vermont Recyclers
Montpelier, Vermont

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To waste, to destroy, our natural resources
. . . will result in undermining in the days
of our children the very prosperity which we
ought by right to hand down to them amplified
and developed.

Theodore Roosevelt, *Message to Congress*
[December 3, 1907].

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The AVR Teacher's Resource Guide for Solid Waste and Recycling Education

Susan Pedicord
Association of Vermont Recyclers

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FOREWORD

Use it up, wear it out,
make it do, or do without.
New England maxim

Long before the present Age of Waste, rural Vermonters practiced thrift and conservation of resources, often by force of necessity. As the wealth and international influence of the United States has grown in the last century, and Vermont has become fully integrated into national and international markets, it has become profitable and easy to waste our resources. Things are designed to wear out, are made to be used once and thrown away, or are simply over-packaged. Ease and convenience, the values implicit in these practices--how alien they are to the Vermont traits of hard work and durability!

As we confront the environmental and economic consequences of our overflowing landfills, two related conclusions are inescapable. Once we make waste, it is costly to dispose of and becomes a potential hazard; and our greatest success will be in reducing the amount of waste we make. As we learn to reduce, reuse, recycle, and compost to lessen waste, we will be renewing in part that spirit of frugality and stewardship of nature that is characteristic of Vermont.

This teacher's resource guide can help us travel such a path of renewal. It will aid those teachers who wish to make our youth aware of how they may reduce waste and safely manage it. Through their efforts, it will involve families, helping provide the critical mass of participation needed to make recycling and composting a reality in many communities. And as youths mature and reducing waste moves from novelty to habit, the teachers who use this guide will have helped restore an ethos of conserving resources to the Vermont character.

As the state-wide, non-profit group dedicated to the best in recycling promotion and education, the Association of Vermont Recyclers is proud to have acted as a catalyst for the compilation of this guide. Please contact us with any questions you have about the Guide or related Guide workshops in your area. We also welcome your comments and suggestions for revision of the Guide in the years ahead. As part of our on-going efforts to aid teachers, we are developing a newsletter and resource kits to introduce new materials useful in the classroom. Please join us in helping bring solid waste and recycling education into Vermont schools.

Curtis B. Johnson, President
Association of Vermont Recyclers

PREFACE

Although there have been a number of teacher's guides for solid waste and recycling published, none have been specific to Vermont or tailored to the needs of its teachers. This guide is meant to remedy that lack. It is also meant to give busy teachers a resource for integrating this important topic into their existing schedules and required courses.

In the belief that a thing easy-to-use will be most used, the Guide has been organized so that by consulting the "How to Use This Book" and the "Sample Activity Page" a teacher will know where to find related activities, information and resources throughout the book. There is therefore no topical introduction to the Guide; the Information section if read consecutively serves that function, while also providing background specific to activity topics.

The activities within each grade-level group were culled or adapted from a variety of sources, a number being written by Vermont teachers. They thus vary greatly in their emphasis and style of presentation. If there is one thing I have learned during the testing phase of this Guide, it is that two good teachers may disagree about what is a good activity; one may prefer a blackboard-oriented lesson, while another prefers for the same activity that students scavenge in the schoolyard. If teachers will keep this relativity of possible presentations in mind, they will find this guide a rich resource for solid waste and recycling related activities that, with minor adaptations, may suit their effective teaching styles.

This project began in the Fall of 1987 when I convinced the Board of the Association of Vermont Recyclers to allow me to undertake this project. To learn how to best go about developing a guide that would be most useful, I then consulted George Tanner of the Vermont Department of Education, who I cannot thank enough for his consideration, guidance, and patience throughout the project. During the fundraising that followed, John Casella made a key financial contribution, encouraging match-monies. The participation of four Supervisory Union school districts--Orange-Windsor, Springfield, Windham Central, and Washington Central--made possible further substantial aid. And Ed Leonard and Pat Parenteau of the Department of Environmental Conservation then lent the support of the Agency of Natural Resources. During the subsequent activity evaluation and testing portions of this project, I had the help of an immense number of knowledgeable and interested people in fashioning the final activity selections found in the Guide; most of them are listed in the Acknowledgements, and I thank them all.

Additional thanks go to Ray Zirblis for loaning me his personal computer and to Eric Gilbertson of the Vermont Division for Historic Preservation for allowing me to use the Division computer when mine was on the blink (which seemed like most of the time). And finally my special thanks to Curtis Johnson, President of AVR, who worked with me to develop and raise funds for this project, who guided and helped me in the preparation of the manuscript for the printer, and whose constant aid and support were invaluable.

Susan Pedicord, Education Coordinator

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The Membership of AVR

Among those who contributed to the development and testing of the Guide, our Project Advisory Committee, who helped shape its form and content and its evaluation and testing programs, included the following individuals: Pamela Ahearn, Union 36 Elementary School; Megan Camp, Director of Education, Shelburne Farms; Kathy Jacob, Clarendon Elementary School; Connie Leach, Resource Conservation Chief, Agency of Natural Resources; Jenephe Lingelbach, Director of Education, Vermont Institute of Natural Science; Chris Miller, Hazen Union High School; and George Tanner, Chief, Curriculum and Instruction Unit, Vermont Department of Education.

In May, 1988, we held a Curriculum Development Evaluation Workshop at the Hulbert Outdoor Center in Fairlee, where teachers reviewed an initial selection of over 120 activities from more than 20 solid waste and environmental curricula and guides from around the country, making deletions and additions, suggesting revisions and writing new activities for the Guide. Those in attendence included: Pamela Ahearn, Union 36 Elementary; Megan Camp, Shelburne Farms; Veronique Collier, Solid Waste Consultant; Mary Alice Leonard Heath, Tunbridge; Cynthia Martin, Calais Elementary School; Jenepher Lingelbach, Vermon Institute of Natural Science; Kathy Jacob, Clarendon Elementary School; Peter Anderson, Marion Cross School; Bonnie Ross, Vermont Institute of Natural Science; Cassie Major, Northfield Elementary School; Gioia Thompson, Burlington Recycling Coordinator; Andre Rouleau, Agency of Natural Resources; Marita Johnson, Riverside Junior High; Beverly Lawson, Newark Street School; Janet Bellavance, Camel's Hump Middle School; Brian Slop U32 High School; Holly Damon, U32 High School; Paul Vachon, Environmental Planner, Agency of Natural Resources; George Tanner, Department of Education; Chris Miller, Hazen Union High School; Bruce Parks, Wilmington High School; Tom McKone, U32 High School; and Alan Kousen, Department of Education.

After suggestions from the May workshop were incorporated into a draft of the Guide, a workshop held in September at the Stowe Ski Dorm, made final revisions of the draft prior t its testing in classrooms. Those who contributed to this day of intense effort included: Pam Ahearn, Union 36 Elementary School; Megan Camp, Education Director, Shelburne Farms; Mary Alice Leonard Heath, Tunbridge, VT: Martha Thomsuden, Lincoln School, Rutland; Kathy Hall, Parent and Recycler, Chittenden, VT; Ginger Johnson, Charlotte Central Elemen tary; Bonnie Ross, Vermont Institute of Natural Science; Nancy Wolfe, Barre Town School; Amy Morse, Warren Elementary School; Kathy Jacob, Clarendon Elementary School; Kathy Magan Smith, Union 36 Elementary School; Peter Anderson, Marion Cross School; Virginia Elliott, Summer Street School; Tom McKone, U-32 Elementary School; Marge Petit, The Cab School; Pam Neff, Edmunds Middle School; Darlene Johnson, The Cabot School; Jeanne Nicholas, Health Coordinator, Killington Mountain School; Marita Johnson, Riverside Junio High; David Book, The Cabot School; Alan Kousen, Science Consultant, Department of Edu cation; Steve Crowley, Agency of Natural Resources; Representative Curt McCormack, Rutland, VT; and Becky Miller, Randolph High School.

Kathy DeSilvey deserves special thanks for helping organize and lead the September workshop and for organizing and leading nine activity-testing workshops during October an November of 1988. Those who reviewed and tested activities in these workshops and in the

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classrooms later are as follows:

--From a workshop sponsored by the Windham County Regional Solid Waste District in Brattleboro: Fern Tavalin, Grade 7-8, Putney Central School; Wayne D. Lyford, Grade 7, Brattleboro Union High School; Barbara Namislo, Grade 5, Oak Grove School; Nancy Pritchard, Grade 6, Oak Grove School; and Kimberly Butler, Vernon Elementary School.

--From a workshop sponsored by the Addison County Regional Planning Commission at the Cornwall Elementary School: Mark Rondeau, Grade 3; Paul Kaplan, Grade 5; Sue Sears, Grade 2; Rich Isenberg, Grade 6.

--From a workshop sponsored by the Central Vermont Solid Waste District at Warren Elementary School: Amy Morse, Grade 5; Joanne Buck; Barbara Ellingson; Susan Dirmaier, Grade 4; Nancy Phillips; Linda Heaton, Grade 1; and Sharon Howland, Grades 2-3.

--From a workshop sponsored by AVR at the Randolph Union High School: Bill Dunkelberger, Grade 7; Rebecca C. Miller, Grade 7; Dean B. Meltzer, Grade 8; Edie Benson, Grade 8; Tom Schersten, Grade 8; Mark MacDonald, Grade 8; Gary Finch, Grade 7; and Judy Jarvis, Grades 7 and 8.

--From a workshop sponsored by the NH/VT Solid Waste Project at Riverside Junior High School: Marita Johnson; J.J. Charest; Robert Swanson; Karin L. Robbins; Brian Haskell; Duncan McCutchan; George Noor, Grade 8; Heather Gowan, Grade 6; and Joanne Kraft, Grade 7.

--From a workshop sponsored by AVR at the Newark Street School: Mrs. Hagman, Grades 3-5, and Beverly Lawson, Grades 6-8.

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And finally, those exceptional teachers who authored activities in this guide include Kathy Jacob, Pamela Ahearn, Brian Slopey, and Tom McKone.

Thank you all.

Section Organization

This book is organized into sections for K-3 Activities, 4-6 Activities, 7-8 Activities, 9-12 Activities, an Information section, and a Resources section. The beginning of each of these sections is identified by a divider with a tab with the section name on it.

Conceptual Outline and Numbering

Each of the activity sections as well as the Information section is organized according to the same conceptual framework, outlined for reference (e.g. I.A., III.B., II.C.). Each activity within the conceptual outline has a sequential number (e.g. 1, 2, 3). The conceptual outline reference and activity number are combined in the upper right-hand corner of each activity page; thus activity number 3 under conceptual question III.C. in the K-3 activities has "K-3 ● III.C.3" in its upper right-hand corner. (The conceptual framework organizes activities and information but is NOT meant to serve as a unit of study.)

The Resources section is organized and numbered pragmatically by Vermont resources, national resources, and bibliographies. It is not organized according to the conceptual framework that is used to organize the activities and Information sections.

Finding Parallel Activities and Information

By looking up the same conceptual outline reference in each activity section or in the information section, you will find parallel activities and information related to topic of activities. For example, for activity K-3 ● III.C.3, any parallel activities can be found under section III.C. in the 4-6, 7-8, or 9-12 activity sections, and related information can be found in section III.C. of the Information Section.

Interrelation of Activities

Each activity may be used with others or alone. It is up to teachers to create their own study units; these activities are meant as an aid to that end. Many of the activities, though found in one grade-level group, are well-suited to other ages as well. Because of space limitations, different approaches to teaching about one subject are spread throughout the four grade-level sections and are not repeated in each grade-level section. It is recommended that all activities be reviewed before beginning. Then when considering one activity, its parallel activities should be consulted in other grade-level sections for alternate lessons. (Not all topics have parallel activities in all grade-level sections.)

As an example, composting is treated in each grade-level section. In K-3 "Banana Peel Blues" teaches the concept of how composting works. A natural follow-up to this activity is to actually build a classroom compost. 4-6 "Mini Compost" tells how to do this, while the 7-8 and 9-12 activities give details on compost composition and microorganisms in compost. Building a mini-compost may be the best way to introduce composting to high school students before exploring any aspect of a compost in detail.

The Activity Pages

The first page of each activity is headed in black by a conceptual question, beneath which is the title of the activity, its grade level and outline reference number. In the left column of the first page are the Concept, Objective, Method, Materials, Subjects, Skills, Time, Sources, and Resources for the activity, followed by a listing of related activities, information, and resources found in this Guide. At the bottom of the first page, activity Vocabulary is listed. In the larger right column the activity itself begins with background or directly with a leading question, followed on the first and sometimes onto the second page with the Procedure, Evaluation, and Extensions of the activity. The "Sample Activity Page" which follows outlines these parts of the first activity page in greater detail.

The first pages of an activity with black headings are essentially activity instructions for teachers. Following pages with white headings include copycat pages for students, additional background or illustrations. Some of this latter material may be suitable for copying for distribution or to make a transparency. Further information relevant to the topic of an activity may be found by looking up the corresponding outline reference number in the Information Section of the Guide.

References/Resources

Under the "Sources" heading of each activity are found the source of the activity itself first, and then any other sources for supporting information and handouts. A Vermont teacher's name and school afiliation are given if they are the author of the activity; the name "Workshop" indicates that the activity was developed primarily at one of the two Teacher Evaluation Workshops held to review this Guide in May and September of 1988; full citations of all other references may be found under "Bibliographies" in the Resources section of the Guide. If nothing is listed under "Source," or what is listed pertains only to the supporting information or the handouts, Susan Pedicord is the author of the activity.

Under the "Resources" heading are found suggested books, audio-visuals, and other materials that may directly complement the activity. The Information and Resources sections of the Guide may be consulted for full citations and/or on how and where to obtain materials.

Under the "AVR Guide Resources" heading are listed those sections of the Guide related to the topic of the activity, including the titles and outline reference numbers of parallel activities and those sections of the Information and Resources sections that will contain the most helpful information and resources.

HOW DO THE ACTIVITY PAGES WORK?(conceptual questio

SAMPLE ACTIVITY PAGE

K-12 O I.A.

Activity Page

Age Group
K-3, 4-6,
7-8, 9-12

Conceptual Framework
Reference Numbe

Concept
The major concept of the activity, as partially expressed int he leading conceptual question.

Objective
The skills the student is expected to work on and the solid waste concepts to be learned.

Method
A summary statement of the activity action.

Materials
A list of the materials needed for the activity.

Subjects
The three or four major disciplines covered in the activity.

Skills
The three or four major skills addressed in the activity.

Time
Approximate time required to complete the initial activity.

Sources
The source of the activity itself, any supporting information and handouts. Full citations of all curricula sources are listed in Resources.

Resources
Additional sources of information including further reading for teachers and students as well as people and organizations.

AVR Guide Resources

PARALLEL ACTIVITIES
Corresponding activities in other age levels.

INFORMATION
Areas of the Information section which contain information relevant to the activity.

RESOURCES
Resource section areas which may be useful for the activity.

BACKGROUND
Preliminary information or an introduction to the activity. Parallel activities and the Information Section should supply further related information on the topic of the activity. As much as possible, the Information Section organization follows that of the activities.

LEADING QUESTION
A motivational question to initiate interest in the activity.

PROCEDURE
Suggestions for an activity procedure. An effort has been made to leave this section rather loose, unless specific direction (e.g. for an experiment) are required. Any alterations in procedure are expected and encouraged.

EVALUATION
Sample post-activity questions or signposts to determine whether the objectives have been achieved.

EXTENSIONS
Ideas for activities to extend learned OR to illustrate the lesson in another way.

HANDOUTS
Most activities are accompanied by one ore more handouts to be copied for students. Activity pages for teachers are headed in black; student handouts have a white heading band.

Some activities have been loosely adapted from their sources; others have been used with little or no changes from the original. Material photocopied directly is credited at the bottom of the page.

Many activities in one age level are suitable for younger children. Due to space limitations in this guide, we have tried to avoid duplication of activities, while stil covering all the important concepts at each level. One of the parallel activities may present a better activity for your class. Teachers are encouraged to look through other age levels for activities.

Vocabulary: key vocabulary in the activity.

I. WHAT IS WASTE?

A. THE SOLID WASTE STREAM
1. GARBAGE BAG RECIPE
2. LITTER WALK
3. TOO MUCH PACKAGING?
4. WHAT'S HAZARDOUS?

B. NATURAL RESOURCES AND WASTE
1. MACHINE

C. WASTE AND SOCIETY
1. GRANDPARENTS' TOYS
2. IMPRESSIONS WITH E.B. WHITE

II. HOW DO WE MANAGE WASTE?

A. SOLID WASTE HANDLING AND LITTER
1. TAKING TRASH AWAY
2. COME BACK TO ME
3. LITTER GARDEN

III. HOW CAN WE REDUCE WASTE?

A. CHANGING HABITS AND DESIGNS
1. EGG CARTONS
2. YESTERDAY'S PAPER
3. TRASH OR TREASURE?

B. RECYCLING
1. CYCLES
2. WHAT'S RECYCLABLE?

C. COMPOSTING
1. BANANA PEEL BLUES

GARBAGE BAG RECIPE

K-3 ● I.A.

Concept
Solid waste is everything we find useless and throw away.

Objective
Students will define solid waste, identify major components of the waste stream, and begin to question their throw-away habits.

Method
Students will create a classroom trash bag.

Materials
Waste basket, typical trash items from the attached trash bag recipe.

Subjects
Language Arts, Science, Social Studies.

Skills
Reasoning, logical thinking, sorting and classifying.

Time
One class period.

Resources
Current waste stream composition studies.

AVR Guide Resources

PARALLEL ACTIVITIES
4-6 ● I.A.1 Litter Search;
7-8 ● I.A.2 School Trash Analysis.

INFORMATION
I.A.5 Components of the Waste Stream; II.A.3 Litter.

RESOURCES
C.2 Further Reading for Students; C.4 General.

BACKGROUND
Composition studies at Vermont landfills have indicated that almost 60 percent of what we throw away still has a value and could be reused, recycled or composted. Diverting these resources from the waste stream begins with recognizing the resource potential of what we throw away each day. This activity sets the stage for many more by creating a classroom prop you can use over and over for different lessons.

LEADING QUESTION
What kinds of things do we throw away?

PROCEDURE
1. Begin by examining the objects in the classroom trash can. Discuss the differences between trash in different places. What kinds of trash would be found in the cafeteria or in different rooms at home?

2. Cut up the attached list so that each child has only one or two items. Ask them to bring either the item itself or a drawing of the item pasted on cardboard to class the next day.

3. When all the components have been assembled, the garbage bag can be used for different lessons. The contents can be sorted and classified by different packaging types, objects with different resource bases, biodegradable or nonbiodegradable, made from renewable or nonrenewable resources, recyclable or reusable, etc. What can they be recycled into? How could they be reused?

EVALUATION
What is waste? (things we don't use or want anymore) What are resources? (things that we do use or need or value). Name one thing that is waste and one thing that is a resource. Name one thing which you throw away which could be a resource instead of waste.

EXTENSIONS

A. WHO WANTS TO GO TO THE DUMP? Hand one trash object to each student, and have all the students stand together in a group representing one large trash bag. The teacher can be the trash collector who will take the trash away. Describe what happens at a sanitary landfill and ask if anyone really wants to go to the dump. If not, they can be rescued by thinking of a way they can be reused or recycled. Try to save all the items of the trash bag by thinking up alternatives. Discuss ways to redesign products that cannot be recycled or reused. Continue until all the students have been rescued.

B. Make a trash can display showing typical breakdown of different types of trash, as in attached illustration. Use magazines cutouts for a collage. Also bring in real things.

C. Find magazine pictures of things that get thrown out after one use and things that last a long time. Make posters or a display of the two types. Compare each throw away object to the same object fifty or one hundred years ago. (razors, paper napkins, paper grocery bags, ballpoint pens, etc.)

Vocabulary: trash, resource, waste, reuse, recycle.

GARBAGE BAG RECIPE K-3 ● I.A.1

Ingredients of Garbage Bags

This list represents the contents of a typical three-pound residential trash bag, as determined by Vermont solid waste composition studies done in 1986.

one paper plate

one glass jar

an old rag

some junk mail

plastic fresh produce bags

styrofoam cup

newspaper

one plastic detergent bottle

one apple core

dead branches and/or leaves

cardboard cereal box

brick pack juice container

one brown paper bag

one aluminum can

a disposable diaper

corrugated packing box

six-pack ring

plastic film

plastic margarine tub

one banana peel

some dead flowers

cardboard egg carton

chicken bones

plastic cider jug

plastic-coated cardboard milk carton

styrofoam egg carton

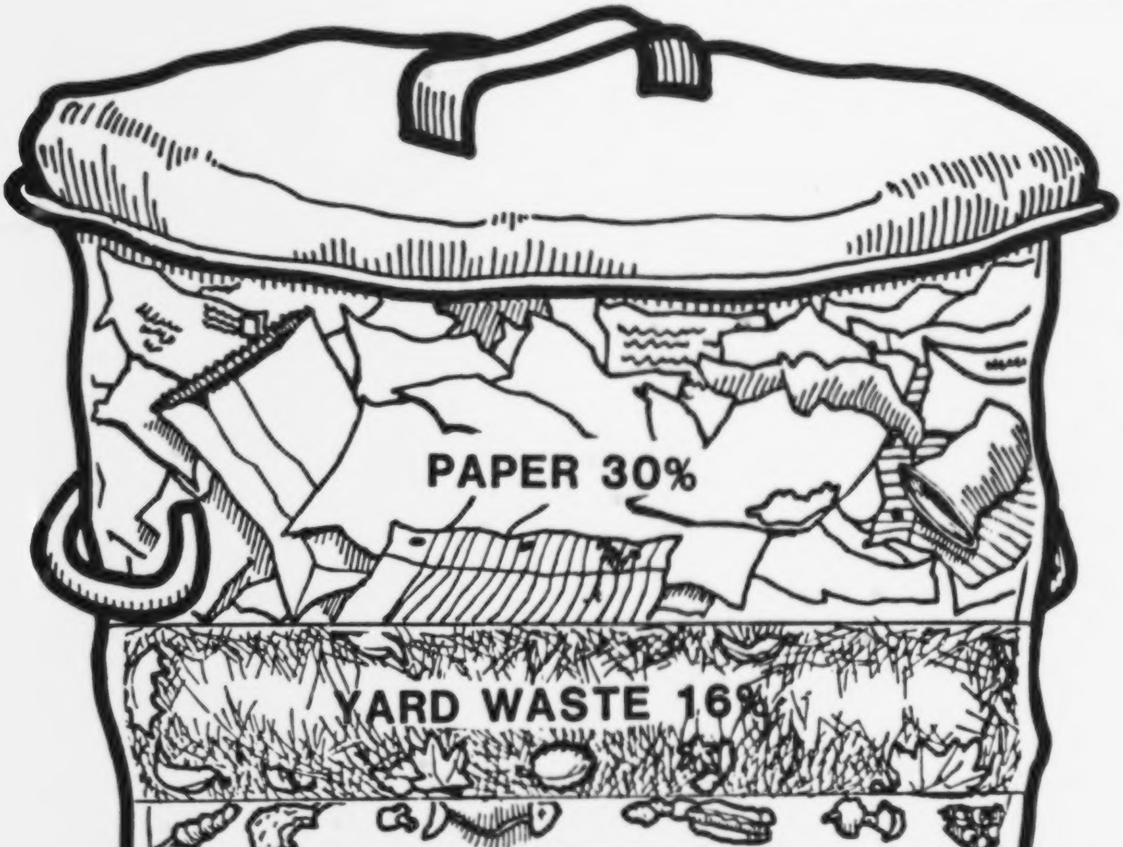
coffee grounds

fast-food restaurant packaging

GARBAGE BAG RECIPE K-3 ● I.A.1

Trash Can Display

This material borrowed from *A Way With Waste* curriculum guide.
A program of the Washington State Department of Ecology.



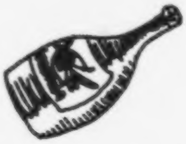
How can we save our resources from being landfilled?

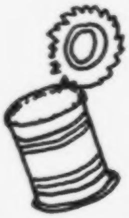
GARBAGE BAG RECIPE

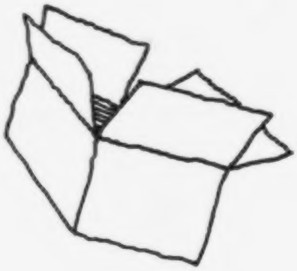
K-3 ● I.A.1

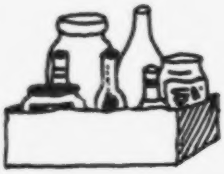
Name: **Date:**

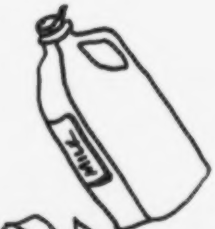
Save these from the trash.
Draw a line from the trash object to its bag of recyclables.

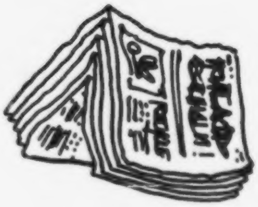


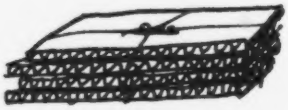


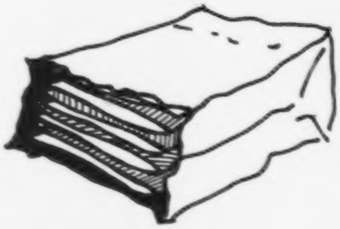


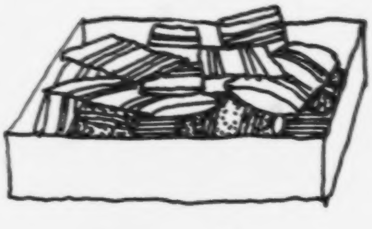


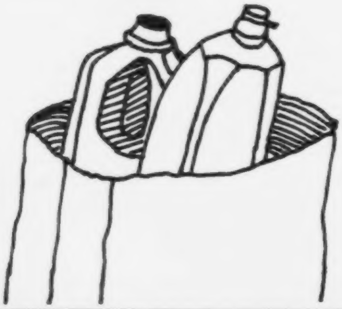












LITTER WALK

K-3 ● I.A.2

Concept
Solid waste can be classified as natural or human-made.

Objective
Students will identify natural and human-made objects while outside and will classify them as litter or not litter.

Method
The class will collect and classify local litter.

Materials
Used lunch bags, local litter, used cardboard for displays or posters.

Subjects
Science.

Skills
Observing, classifying.

Time
One class period.

Source
Operation Waste Watch.

Resources
"Garbage Eaters" *Ranger Rick Magazine* (July 1976); Ann Zane Shanks, *About Garbage and Stuff*; Patricia Lauber, *Too Much Garbage*; Dare Wright, *Edith and Little Bear Lend A Hand.*

AVR Guide Resources

PARALLEL ACTIVITIES

7-8 ● I.A.1 Throwing it all Away;
7-8 ● I.A.2 School Trash Analysis.

INFORMATION

I.A.5 Components of the Waste Stream.

RESOURCES

C.4 General.

BACKGROUND

When waste is disposed of improperly, it is called litter. Litter can be human-made objects such as plastic bags and paper cups. Litter can also be natural materials such as apple cores, fallen leaves or dead flowers. Whether an object is natural or human-made will have an effect on what we should do with it. Natural litter can include seed pods, leaves, and torn branches, all of which nourish and replenish natural systems if they are composted or left in the forest. Human-made litter needs to be sorted and disposed of in special ways. If done properly, this can save some of the natural resources that were used to make it.

LEADING QUESTION

What is the difference between human-made and natural litter?

PROCEDURE

1. Write the words "natural" and human-made" on the blackboard. Ask each child to look around the room, name an object, and tell whether it is natural or human-made. Have each child touch the object he or she names and tell the primary use of the object.

2. Have the class make litter bags from their used lunch bags.

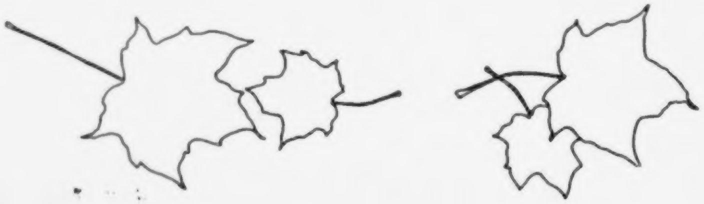
3. Take the class on a short walk around the school yard. Ask the children to name objects they see on the ground, sidewalk, street or road side, and decide if they are natural or human-made. Where did each item come from? Does it belong on the ground? If not, where? Explain that when any object, human-made or natural, has been discarded improperly, it is called litter.

4. Pair students and have one child in each pair pick up an example of human-made litter and one pick up a sample of natural litter. Bring the class back and make posters or a display of natural and human-made litter from the collections of the class walk.

5. Ask the students to think of ways nature uses natural litter objects. (Leaves replenish the soil, pine cones can be food for birds or squirrels and spread seeds, etc.) How do people use the natural objects? (People can use natural items to make things and to decorate their homes, or add them to a compost pile for their gardens). Think of a project (compost, natural sculpture, etc.) for the class to do with some of the natural litter.

EVALUATION

What is litter? What kinds of litter are there? How should we dispose of the following kinds of litter? (list of examples)



Vocabulary: natural, human-made, litter, waste.

LITTER WALK

EXTENSIONS

A. *LITTER BOX:* Ask the custodian for a discarded cardboard box. Decorate it with pictures of nature and label it the "nature's litter." Label the trash can "human-made litter." Ask the students to empty their litter bag contents into the appropriate box. Let them know that it is important to keep natural litter out of the trash because it is still useful to the earth. Make a trip out to the woods or somewhere where the natural litter can be disposed of where it will be of use to the earth and won't be litter.

B. Use the collected natural litter to begin a class compost. See 4-6 ● III.C.1 MINI COMPOST.

C. Make a litter garden to test decomposition rates of different litter. See K-3 ● II.A.3 LITTER GARDEN.

D. *SORTING AND CLASSIFYING*:

- Assemble at least ten natural objects (shell, pine cone, seed tree branch or leaves, stone, moss, apple, bird's nest, piece of fur or hair, sand, earthworm, mulch, pine needles, antler, tooth, flower, egg, etc.) and ten human-made objects (tape, key, plastic toy, shoe, sweater, pencil, envelope, can, glass bottle, candy wrapper, jewelry, button clothes pin, crayon, stapler, ballpoint pen, desk calendar, spoon, etc.)
- Place the assortment on a table where all the children can see them easily. Be sure to include an approximately equal number of both human-made and natural objects.
- Hold up each object and ask the children to say its name. Ask a few students to group the objects on the table by various characteristics such as color, size, hardness and softness, length, etc.
- Now ask the children what "natural" and human-made" mean. Explain that "natural" means all things made by nature that people or machines cannot make. Natural objects are things that were here in the world before people. Natural objects include: all living things, plants and animals and all non-living things --such as rocks, dirt, sand. Human-made means anything in our world that people or machines do make.
- Have the children arrange the objects on the table into these two groups--natural objects and human-made objects.

E. *DRAWING PICTURES:* Ask the children to draw two pictures - one with four human-made objects in it and the other with four natural objects in it.

F. *MORE CLASSIFYING:* Put a sign reading "Natural Objects" on one desk or table and a sign reading "Human-made Objects" on another. Ask each of five children to find a natural object in the classroom and place it one the "Natural Objects" desk. Do the same for the "Human-made Objects" desk. Discuss the characteristics of each group of objects. (For example, plants are one important type of natural object, and plants are often green in color.) Have the students use their senses of touch, smell, sight, hearing, to help describe the characteristics of the objects. Help the class find any misplaced objects and group them correctly. Name some object not in the classroom. Ask a student to tell whether it is natural or human-made. Have students name other objects outside the classroom and ask other individuals to correctly classify their examples.

G. *FEELING GAME:* Make a "surprise box" by cutting a fist-size hole in the side of a covered corrugated box. Decorate the outside of the box to increase the children's interest in it. Put several small natural and human-made items in the box. Change the items every few days. Ask the children to reach inside the box with their eyes closed. Tell them to pull out three natural objects and three human-made objects using

TOO MUCH PACKAGING?

K-3 ● I.A.3

Concept
Packaging is a major component of the waste stream.

Objective
Students will examine over-packaging.

Method
Students will unwrap and count gum wrappers and make posters.

Materials
Enough packages of sugarless gum for each student to have one piece (or other multiple-wrapped treats such as Andre mints), construction paper, glue.

Subjects
Math, Art, Social Studies.

Skills
Counting, hypothesizing, deductive thinking.

Time
One class period.

Sources
A Way With Waste;
Betty Miles, *Save The Earth.*

Resources
Anne Shanks, *All About Garbage.*

AVR Guide Resources

PARALLEL ACTIVITIES
4-6 ● I.A.3 The Story Of...;
7-8 ● I.A.3 Potato Cakes;
9-12 ● I.A.2 Packaging Preferences.

INFORMATION
I.A5 Components of the Waste Stream; I.A.7 Packaging.

RESOURCES
A.10 Vermont Businesses;
B.4 Industry Associations;
C.8 Plastics and Packaging.

BACKGROUND

Estimates of the percentage of household waste that is packaging range from 20 to 40%. Packaging of some kind is necessary in many cases to protect food and keep it clean and free from contaminants, but composite and duplicate layers of packaging often add unnecessarily to the waste stream and are not recyclable. For instance, paper packaging coated with plastic or aluminum prevents it from ever being recycled. We are rarely aware of how much waste we produce, especially when we throw out one candy wrapper at a time, but lots of little pieces add up quickly to a surprisingly large amount. We can each help reduce the volume of solid waste plaguing our society by choosing products which produce less and/or recyclable waste.

LEADING QUESTION

Do you think eating one piece of gum will have much effect on the size of our trash pile?

PROCEDURE

1. Read and discuss the poem: "How The Trash Pile Grows." Do you think this is what we should do? Why? What does it mean by, "Oh, no - where is "away"?

2. Divide students into groups with the same number of students as there are pieces of gum per package. Pass out one package of different sugarless gum to each group, and ask them to carefully unwrap the gum without tearing the wrappers.

3. Have each group create a poster by gluing all the wrappers and the packaging on a piece of construction paper. Glue wrappers in patterns, grouping them in fives or tens so they can be easily counted.

4. When the posters are finished, ask the children to guess how many wrappers there are, and then to count them. As a class, figure out, if you chewed one pack of gum a week, how many separate wrappers would you be adding to the waste stream each week? each year?

5. Discuss the reasons why there are so many wrappers. Identify the possible purposes of each layer. Ask the students how they would package the gum. What are the reasons for their design choices?

6. Ask the children to identify the source of raw materials for packaging: i.e., the plastic, the aluminum foil, the paper. Discuss depletion of natural resources and possible ways to conserve these resources (i.e. recycling, reusing, using less, etc.)

7. Ask children to think of other things that their families buy that come in packages. What things have the most number of separate packaging pieces per package? (Consider individually wrapped sliced cheese, candy, crackers, single serving instant foods and beverages, etc.) If we reduce the amount of packaging, will we reduce the amount of trash? Brainstorm ways to reduce packaging.

Vocabulary: packaging, composite, layers, natural resources, trash.

TOO MUCH PACKAGING?

EVALUATION

Students should be able to define recycling. Name two types of packaging which are difficult to recycle and two which are easy to recycle. How can you reduce the amount of packaging in your trash can?

EXTENSIONS

A. Have students think of one thing they enjoy eating that uses a lot of packaging. And then, one thing that uses very little packaging. Can they choose to eat the kind that uses less? Does the same product come in different types of packaging, so they can choose the least amount of packaging and still have their favorite food?

B. How long will the wrappers take to decompose? Bury a sample of each of the different wrappers in the ground. Check after one week, one month, and six months. Also see: K-3 ● II.A.3 LITTER GARDEN.

C. Try the attached "Wrapping and Unwrapping" activity.

D. Compare and make displays of "Nature's Packaging" and "People Packaging." Why is Nature's Packaging useful to the earth?

E. Visit a coop and grocery store and compare packaging.

F. Look for food products made from recycled materials. Write letters to companies thanking them for using recycled material or asking them to use recycled packaging.

How the Trash Pile Grows

Buy it,
try it,
throw the trash away!

Take it,
break it,
throw the trash away!

Get it,
use it,
finish it,
lose it.
Wear it,
tear it,
throw the trash away!

Soda pop,
box top,
once you start
you can't stop.
Buy it,
show it
nothing left but throw it:

Throw the trash away!

(Oh, no-where is "away"?)

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TOO MUCH PACKAGING? K-3 ● I.A.3

Name: **Date:**

Unwrapping and Unwrapping

a 15 minute project

Try this when someone in your family has come home from the store with lots of groceries.

Put an empty waste-basket near the table. Now start unwrapping the groceries before you put them away.

Put every piece of wrapping in the waste basket:

cardboard boxes
ice cream bags
plastic bags
paper bags
cardboard cartons

Did you collect a wastebasket full of wrappings? Do you think all those wrappings were really necessary?

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WHAT'S HAZARDOUS? K-3 ● I.A.4

Concept
Many household products are hazardous in the home and after disposal. They must be carefully separated from regular waste.

Objectives
Students will be able to define household hazardous waste, poison, toxic, and identify examples of these products and places they may be found.

Method
Students will study pictures of common household hazardous products, and will match pictures to places found.

Materials
Pictures of common household hazardous wastes, Mr. Yuk stickers from Vt. Poison Center, magazines, examples of hazardous materials containers, attached worksheet.

Subjects
Science, Social Studies, Health.

Skills
Classifying.

Time
One class period.

Source
Toxics In My Home? You Bet!

Resources
Vermont Poison Center; VPIRG; VPIRG Update, Spring 1988; Art Hazards Information Center.

AVR Guide Resources
PARALLEL ACTIVITIES
9-12 ● II.B.4 Toxic Waste in the Lab.

INFORMATION
I.A.5 Components of the Waste Stream;

I.A.6 Hazardous Materials;

I.A.7 Packaging.

RESOURCES
C.9 Household Hazardous Waste.

BACKGROUND
Almost every home in the United States contains a number of hazardous chemicals stored in their garages, basements, bathrooms and kitchens. Oven and drain cleaners, auto cleaners and lubricants, paints, thinners, strippers, and varnishes, bathroom cleaners, metal cleanersand polishes, pesticides, used motor oil and gasoline are just some of the hazardous substances estimated to amount to between three and ten gallons in the average home. These products range from poisonous and cancer-causing to flammable and corrosive, and if not disposed of properly, may contaminate ground water, which supplies drinking water for most Vermonters.

LEADING QUESTION
What does "toxic" mean?

PROCEDURE
1. Discuss the meaning of the words poison, toxic, hazardous. Explain that many of the products we use every day are toxic and must be used and disposed of carefully.
2. Display different examples of household hazardous materials, explain why they are potential problems. Ask the students to identify some places these products might be found. Picture or labels of rooms in a house posted on a bulletin board will aid students in classifying.
3. Students bring handout home to their families. Report on discussion with their parents.

EVALUATION
Students should be able to name some toxic products they found in their home that should not be placed with regular waste.

EXTENSIONS
A. Students can make collages of household hazardous wastes from pictures found in housekeeping magazines, and paste Mr. Yuk stickers to each of the objects/pictures in the collage.

B. Class could make a display of common toxic and non-toxic household products and identify the toxics with Mr. Yuk stickers.

C. Order enough Mr. Yuk stickers from the Vermont Poison Center so that each student has one set. Compose a class letter for parents telling what the class has learned and asking the parent to help the student identify the hazardous products in their home with a Mr. Yuk sticker. The students could make a list of all the products in their home to bring back to class to discuss.

D. Take a survey of classroom art supplies to make sure you aren't using anything dangerous. Obtain a list of "Products authorized to bear the CP Certified Products Seal, the AP Approved Product Seal and the HL/NT Health Label/Non-Toxic Seal of the Art and Craft Materials Institute, Inc. (Available from The Art and Craft Materials Institute, Inc., 715 Boylston Street, Boston, MA 02116 (617) 266-6800.) These products are certified in a program of toxicological evaluation by a medical expert to contain no materials in sufficient quantities to be toxic or injurious to humans or to cause acute or chronic health problems. You may want to reconsider using any products which are not on this list.

Vocabulary: poison, toxic, household hazardous waste.

WHAT'S HAZARDOUS? K-3 ● I.A.4

Name: **Date:**

Dear Family:

Today we learned that many of the products we use every day at home contain things that can make our water, earth and air dirty and could make us and other living things sick. Did you know that toilet bowl cleaner, furniture polish, flea powders, moth balls, drain openers, paints and varnishes, automobile oil and antifreeze, rug cleaners, rat poison, room deodorizers, oven cleaners, car and household batteries, bug and weed killers, and even scouring powders and window cleaners can all be dangerous? If we left some of these where babies or small children could reach them, they might get poisoned or burned. And if we throw them away improperly, they might hurt trash handlers or poison our environment.

For many years we didn't understand that these products might be dangerous. Many of our dumps have been filling up and contaminating our soil and water and air. But now Vermont state and regional solid waste districts are working very hard to make sure that the places we send our trash in the future will be safe and clean. New Vermont landfills will be lined to keep toxics out of our soil. Leachate (the dirty water from landfills) will be collected and cleaned before it can get into our streams and wells. We can help. Let's be careful to read labels and store, handle anduse these products properly. Using less or using nontoxic alternatives is the best way to help keep our environment clean, and disposing properly of products we already have is important! Let's call our solid waste district office at ____________________ for more information on hazardous household waste collections in our area!

MACHINE

K-3 ● I.B.1

Concept
The earth is the ultimate source of everything we make, use and throw away.

Objective
Students will develop an awareness of the natural origins of many products and will realize the limited availability of some natural resources.

Method
Students will pretend they are machines making objects.

Materials
Four bulletin boards, common objects or pictures from magazines (see bulletin board illustration).

Subjects
Science, Language Arts.

Skills
Communicating, sorting and classifying, observing.

Time
One or more class periods.

Sources
Recyculum, Pamela Ahearn, East Corinth Elementary.

AVR Resources
Parallel Activities

4-6 ● I.A.1 What Kind of Waste Am I? 7-8 ● I.B.1 Resource Protection Game;
9-12 ● I.B.1 Nonrenewable Resources.

INFORMATION

I.A Waste and natural resources;
I.B Components of the waste stream.

RESOURCES

A.10 Vermont Businesses;
B.4 Industry Associations;
C.4 General.

LEADING QUESTION
Where do the things we use come from?

PROCEDURE
1. Illustrate the following bulletin board ideas showing the four natural resource categories of minerals/oil, minerals/rock, plants, and animals and several products which are made from them. Using products from home or pictures cut from a magazine, have kids match the object to the correct resource. Set the bulletin boards up at stations around the room.

2. Set up a machine by draping a sheet over four chairs, two on each side with a crawl space between. Choose two students to play the roles of electricity and gas. When a student enters the machine, electricity and gas will make machine-like noises.

3. Assign the role of one of the four natural resources to each student. (For younger children, use only one of the resource categories at a time.) As each student comes to the back of the machine, and is hidden from the class, the teacher hands the student a finished product made from the resource. The student enters the machine (which begins to make machine noises), and comes out holding the finished product, which is then deposited at the proper station.

4. After each student has gone through the machine, the class will discuss renewable and nonrenewable natural resources. Where does the oil and gas come from? Can we grow more oil? If we buried the plastic doll, would it go back to oil? Can we grow more trees? animals? minerals? What can we do to avoid using up all our resources?

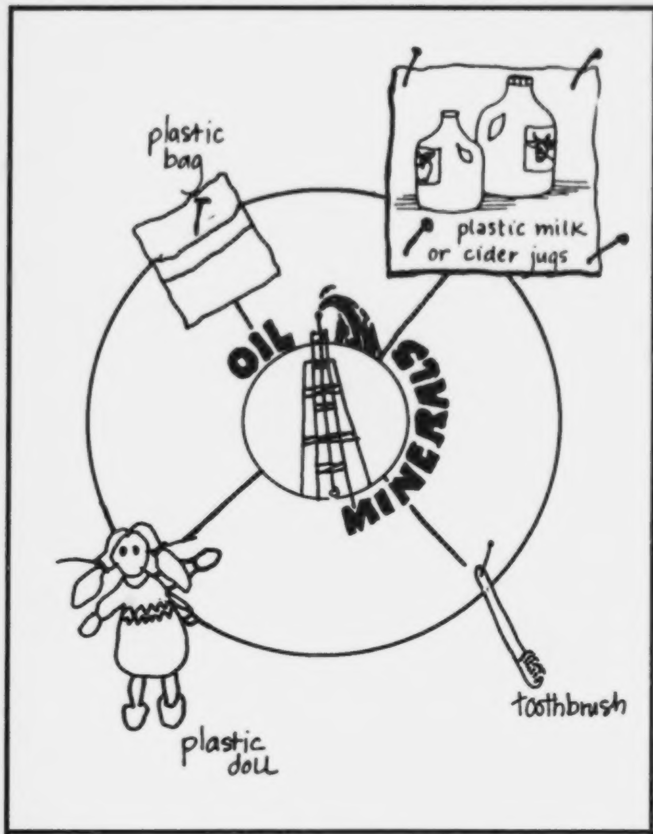
EVALUATION
What is the source of everything we use? What can we do to help save limited natural resources?

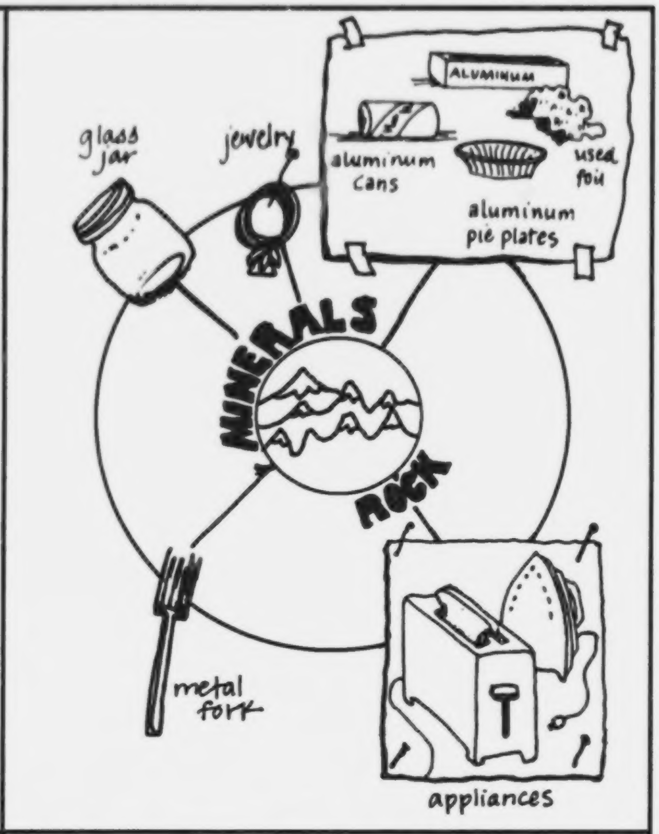
EXTENSIONS
A. Show kids how natural resources can be recycled by taking finished products through the machine and recycling them into different new products. For example, a newspaper becomes a cereal box. A plastic soda bottle becomes a ski jacket.

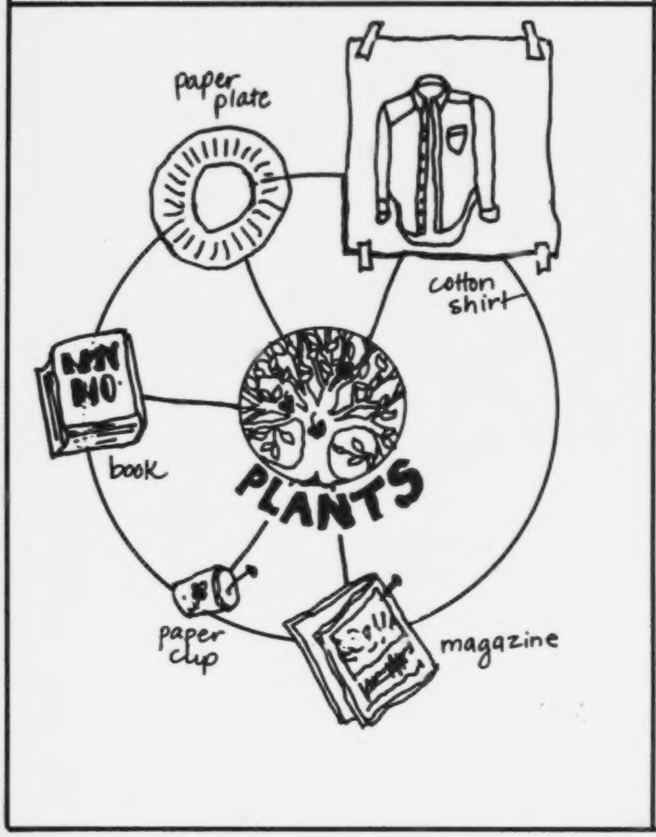
B. Give students small portions of clay to model into objects they like to use. When they are finished, have them put the clay objects into one of three boxes labelled BURN, BURY, and LITTER. Explain that these are three ways that we dispose of the things we don't want any more. Have the students continue making objects and disposing of them until there is no more clay left. Discuss the similarities between the clay and our earth. How can we prolong the life of our earth and its resources?

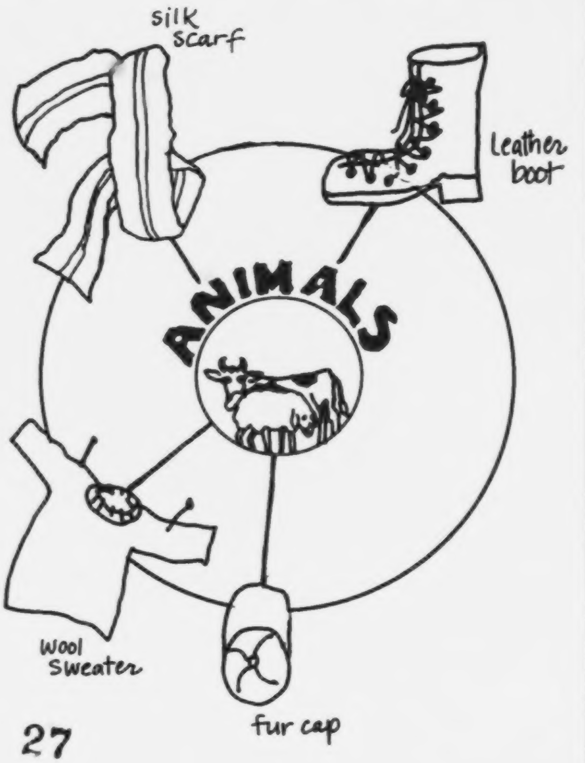
Vocabulary: natural resources, machines, mineral, oil, source, nonrewable resources.

Natural Resource Bulletin Board









GRANDPARENT'S TOYS

K-3 ● I.C.

Concept
Solid waste contains more and more mass-produced objects and synthetic materials.

Objectives
Students will become familiar with the changes in the amount of material consumed and the types of materials used to make things. They will relate these changes to our solid waste disposal problems.

Method
Students will interview older persons in their community.

Materials
Pictures or examples of antique toys, children's favorite toys.

Subjects
Language Arts, Social Studies.

Skills
Describing and comparing, formulating questions.

Time
One class period; outside class interviewing time; one class follow-up.

Source
Recycling Study Guide.

Resources
Books on making old-fashioned toys; local historical societies; antique shops; Shelburne Museum; Vt. Council on the Arts.

AVR Guide Resources

PARALLEL ACTIVITIES
4-6 ● I.C.1 Then and Now;
7-8 ● I.C.1 Trash Timeline;
9-12 ● I.C.3 The Dump Ground.

INFORMATION
I.C Waste and Society;
III.A.2 Reuse Ideas.

RESOURCES
C.1.c Reuse Activities.

BACKGROUND
Toys have changed through the years. At one time, most were made of natural objects. Then they were made of papier-mache, or were handmade country toys like whirligigs, bean shooters, yo-yos, limber jacks and tops. Over time, commercially manufactured toys became available, like wooden Lincoln Logs and tinker toys and metal Erector Sets. Then plastic toys came on the market - toy guns, frisbees, hula hoops and plastic models. Now, battery-operated and electronic toys, pinball games, video games and computers are popular.

LEADING QUESTION
Do you have a favorite toy at home?

PROCEDURE
1. Have you ever had a favorite toy that didn't last very long? What happened to it? What was it made of? Have students bring in toys-that are broken and might be thrown out. What are they made of? How long did they last? How would the children redesign the toys to last longer? How might these broken toys be fixed or made into new toys?

2. Ask them if they've seen any of their grandparents' or other old toys. Discuss the change in materials that toys are made from, how they are made, etc. Discuss toys made in other cultures and at other times in history. Examples of old-fashioned toys such as whirligigs or wooden blocks would be most helpful here. How are they different from modern toys? How are toys made in other cultures or at other times in history different from our toys?

3. Develop a list of questions with the students that they might ask an older person about old toys. Questions might include:
- What were your favorite toys when you were little?
- How many toys did you have? What were your toys made of?
- Who made them? How long did your toys last?
- Could they be fixed if they broke?
- Would it have been cheaper to fix the toy or get a new one? Why?
- If broken toys could not be repaired, what did you do with them?
- How are toys sold today different from those you had?

4. Have each student interview an older person at home or in the neighborhood, have an older person come to the class, or take a field trip to a nursing home or senior citizen center to interview people. Taping would allow rest of class to learn and share.

5. Discuss the differences discovered. How might these differences affect our natural resources and what we throw away? What has happened to the toys that our grandparents threw away? What will happen to our own toys when we throw them out?

EVALUATION
What kinds of toys are better for our environment?

Vocabulary: plastic, natural materials, whirligigs.

GRANDPARENT'S TOYS

K-3 ● I.C.1

EXTENSIONS

A. Take a field trip to a local museum, library, or historical society to look at their old toys collection.

B. Find out how some of the old toys were made (corn husk dolls, whirligigs, etc.) and make some in class.

C. Have each student choose and write a report about a toy that was popular in a different time and culture. (Abenaki Indian toy, Prairie Indian toy, Egyptian toy, etc.)

D. Have children design and make their own toy from natural objects. They can make one and give it to another child.

E. Make paper hats, boats, etc. from scrap paper.

Cornhusk doll, late 19th century...

IMPRESSIONS WITH E.B. WHITE K-3 ● I.C.2

Concept
By redefining waste as a resource, we can help solve our solid waste problems.

Objectives
Students will listen and respond to excerpts from stories, will predict story outcome, will define garbage and evaluate their first impressions of it, and will develop reasoning skills by looking for more productive alternatives.

Method
Students will listen to excerpts from E.B. White's *Charlotte's Web* and *Stuart Little*.

Subjects
Language Arts, Social Studies.

Skills
Creative writing, listening, reasoning, predicting.

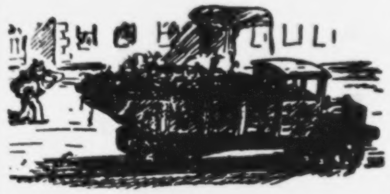
Sources
E.B. White, *Charlotte's Web*;
E.B. White, *Stuart Little*.

Resources
Lawrence Pringle, *Throwing Things Away*; garbage barge articles.

AVR Guide Resources
PARALLEL ACTIVITIES
4-6 ● I.C.1 Then and Now;
7-8 ● I.C.2 Art Reflecting the Environment;
9-12 ● I.C.3 Shopper Survey;
9-12 I.C.4 GNPP.

INFORMATION
I.C Waste and Society;
II.C Public Planning and Policy.

RESOURCES
C.2 Further Reading for Students.



BACKGROUND
The terms waste and resource are relative and reflect our own needs and values rather than any objective quality of an object. How we feel about garbage will have a lot to do with how we take care of it. By redefining their view of the whey waste created in making ice cream, Ben and Jerry's was recently able to alleviate a waste disposal problem as well as to provide a local farmer with pigs and a steady supply of food for them.

LEADING QUESTION
What do you think of when I say "garbage"?

PROCEDURE

1. There will probably be a negative reaction. Explain that the class is going to read about someone who probably feels the same way they do about trash. Stuart Little is a mouse who lives in the city and is always getting into trouble. This is about one of Stuart's misfortunes, when he accidentally gets caught in a garbage can. Read the following quote from *Stuart Little:*

> *The men threw the can with a loud bump into the truck, where another man grabbed it, turned it upside down, and shook everything out. Stuart landed on his head, buried two feet deep in wet slippery garbage. All around him was garbage, smelling strong. Under him, over him, on all four sides of him--garbage. Just an enormous world of garbage and trash and smell. It was a messy spot to be in. He had egg on his trousers, butter on his cap, gravy on his shirt, orange pulp in his ear, and banana peel wrapped around his waist.*
>
> *Still hanging on to his skates, Stuart tried to make his way up to the surface of the garbage, but the footing was bad. He climbed a pile of coffee grounds, but near the top the grounds gave way under him and he slid down and landed in a pool of leftover rice pudding. "I bet I'm going to be sick at my stomach before I get out of this," said Stuart.*

2. Discuss how Stuart felt about garbage. Why didn't he like it? Explain that what was unpleasant for Stuart might be a field day for someone else. Read the following quote from *Charlotte's Web*: Examples of old-fashioned toys such as whirligigs or wooden blocks would be most helpful here. How are they done?

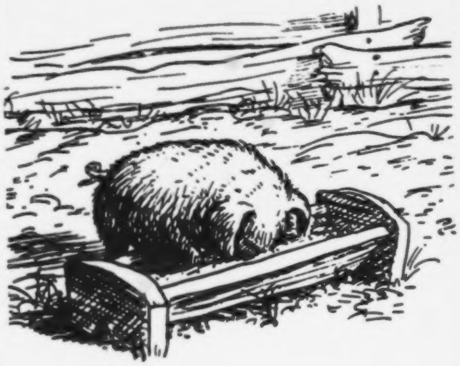
> *Lurvy dragged Wilbur's trough across the yard and kicked some dirt into the rat's nest, burying the broken egg and all Templeton's other possessions. Then he picked up the pail. Wilbur stood in the trough, drooling with hunger. Lurvy poured. The slops ran creamily down around the pig's eyes and ears. Wilbur grunted. He gulped and sucked and gulped, making swishing and swooshing noises, anxious to get everything at once. It was a delicious meal-- skim milk, wheat middlings, leftover pancakes, half a doughnut, the rind of a summer squash, two pieces of stale toast, a third of a gingersnap, a fish tail, one orange peel, several noodles from a noodle soup, the scum off a cup of cocoa, an ancient jelly roll, a strip of paper from the lining of the garbage pail, and a spoonful of raspberry jello.*

Vocabulary: garbage.

IMPRESSIONS WITH E.B. WHITE

K-3 ● I.C.2

How did Wilbur feel about garbage? Point out that Wilbur's garbage was useful and not wasted. Our own garbage can also be a resource. Brainstorm possibilities, including composting, pet pigs, tree houses out of construction debris, fixing broken toys, etc.



3. Bring the children back to *Stuart Little* to find out what happens to him.

> *There was no way for him to get out of the truck, the sides were too high. He just had to wait. When the truck arrived at the East River, the driver drove out onto the pier, backed up to a garbage scow, and dumped his load. Stuart went crashing and slithering along with everything else and hit his head so hard he fainted and lay quite still, as though dead. He lay that way for almost an hour, and when he recovered his senses, he looked about him and saw nothing but water.*
>
> *The scow was being towed out to sea. "Well," thought Stuart, "this is about the worst thing that could happen to anybody. I guess this will be my last ride in this world." For he knew that the garbage would be towed twenty miles out and dumped into the Atlantic Ocean."*

4. Discuss what happens not only to Stuart but to all the garbage. Are they really going to dump it in the ocean? What effect will this have on the water and the creatures living in it? Brainstorm positive alternatives which would treat garbage as a resource as in *Charlotte's Web.*

EVALUATION

Have students write and illustrate their own ending to Stuart's story.

EXTENSIONS

A. Explore the different interactions between animals and garbage. What effect does human waste disposal have on animals? Consider skunks, bears, polar bears, raccoons, rats, seagulls, etc. (Read Lawrence Pringle, *Throwing Things Away).*

B. Write your own adventure story about an animal and solid waste.

C. Do the Litter in a Lake Experiment Handout (K-3 O II.A.2 COME BACK TO ME).

D. Start a class compost. (See K-3 O III.C.1 BANANA PEEL BLUES and 4-6 O III.C.1. MINI COMPOST.)

Quotations and illustrations from:

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Williams: Harper & Row. Publishers. New York.

Charlotte's Web. Copyright 1952 By E.B. White:
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TAKING TRASH AWAY

K-3 ● II.A.1

Concept
Trash has to go somewhere, and there are limited disposal options.

Objective
Students will recognize the importance of taking trash away and learn where their trash goes.

Method
Students will interview school custodians and trash collectors, will observe trash removal, and will create a mural depicting waste collection and disposal.

Materials
Large roll of mural paper, drawing materials, a few trash samples.

Subjects
Language Arts, Science, Social Studies, Art.

Skills
Formulating questions, interviewing, experimenting.

Time
One prep class to develop questions, one class period to interview, one class follow-up activity.

Source
Shel Silverstein, *Where the Sidewalk Ends.*

Resources
Local waste haulers, school custodian; Patricia Lauber, *Too Much Garbage*; Paul Showers, *Where Does the Garbage Go?*

AVR Guide Resources

PARALLEL ACTIVITIES

K-3 ● II.A.2 Come Back To Me;
4-6 ● II.A.1 Hauling It Away;
7-8 ● II.A.3 Trash Haulers.

INFORMATION

II.A Transportation and Processing; II.C Act 78 Summary.

RESOURCES

C.4 General.

LEADING QUESTIONS

Why do we have to take the trash away? Where does it go?

PROCEDURE

1. Read and discuss the attached poem, "Sarah Cynthia Sylvia Stout" by Shel Silverstein. What do you think happened to Sarah Cynthia Sylvia? Why is it important to take the garbage out? Once it's out, where does it go?

2. Invite the school custodian to class and ask him about his trash removing duties: How much of his day is devoted to removing trash? Where does he take it? How often is it picked up? What is most of the trash composed of? How much do we throw out each week? What does it cost to throw it out?

3. Arrange a short interview with the school's trash hauler for the next time they are scheduled for a pick up. When the trash truck comes, have the class watch the removal process. Then ask the trash collector about his or her business:

> When do you start working in the morning and finish at night?
> How many truckloads of trash do you collect each day?
> Why is your truck designed the way it is and how does it work?
> How many houses and or businesses do you collect from?
> How many miles do you drive each day?
> Do you ever pick up recyclables separately?
> Why or why not? Where do you take the trash?
> What happens to it then?

4. On the basis of the interview, have the class construct a mural depicting all the stages in creation, collection and disposal of waste. Add specific facts learned in the interview and display the mural in the school to teach others.

EVALUATION

Why are trash haulers so important? Where do they take our trash?

EXTENSIONS

A. Take a field trip to a landfill.

B. Have students conduct similar survey/interviews at home or with kitchen staff at school.

C. Determine costs for waste disposal for the school for a year. Determine how much paper and/or organic wastes the school produces and devise a recycling or composting program which will help the school save money.

Vocabulary: trash, garbage, trash hauler.

"SARAH CYNTHIA SYLVIA STOUT"

by Shel Silverstein

Sarah Cynthia Sylvia Stout
Would not take the garbage out,
She'd wash the dishes and scrub the pans
Cook the yams and spice the hams,
And though her parents would scream and shout,
She simply would not take the garbage out.
And so it piled up to the ceiling:
Coffee grounds, potato peelings,
Brown bananas and rotten peas,
Chunks of sour cottage cheese.
It filled the can, it covered the floor,
It cracked the windows and blocked the door,
With bacon rinds and chicken bones,
Dripply ends of ice cream cones,
Prune pits, peach pits, orange peel,
Gloppy glumps of cold oatmeal,
Pizza crusts and withered greens,
Soggy beans, and tangerines,
Crusts of black-burned buttered toast,
Grisly bits of beefy roast.
The garbage rolled on down the halls,
It raised the roof, it broke the walls,
I mean, greasy napkins, cookie crumbs,
Blobs of gooey bubble gum,
Cellophane from old bologna,
Rubbery, blubbery macaroni,
Peanut butter, caked and dry,
Curdled milk, and crusts of pie,
Rotting melons, dried-up mustard,
Eggshells mixed with lemon custard,
Cold French fries and rancid meat,
Yellowed lumps of Cream of Wheat.
At last the garbage reached so high
That finally it touched the sky,
And none of her friends would come to play,
And all the neighbors moved away;
And finally, Sarah Cynthia Stout
Said, "Okay, I'll take the garbage out!"
But then, of course, it was too late,
The garbage reached across the state,
From New York to the Golden Gate;
And there in the garbage she did hate
Poor Sarah met an awful fate
That I cannot right now relate
Because the hour is much too late
But children, remember Sarah Stout,
And always take the garbage out.

Text and illustrations from Shel Silverstein, *Where the Sidewalk Ends*, Copyright (c) 1974 by Shel Silverstein. Reprinted by permission from Harper & Row, Publishers, Inc.

COME BACK TO ME

K-3 ● II.A.2

Concept
Nowhere is away.

Objective
Students will understand the problem society is having with proper placement of solid waste and that nowhere is away. Students will recognize the importance of taking trash away.

Method
Students will sing a song and discuss its meaning.

Materials
Chart with words of song on it.

Subjects
Music, Language Arts, Science, Social Studies.

Skills
Brainstorming, communicating, formulating questions, predicting, hypothesizing, problem solving.

Time
35-40 minutes.

Sources
Pamela Ahearn, U-36 Elementary, East Corinth; Betty Miles, *Save The Earth; Operation Waste Watch.*

AVR Guide Resources

PARALLEL ACTIVITIES
K-3 ● II.A.1 Taking Trash Away;
4-6 ● II.A.1 Hauling It Away;
9-12 ● II.A.1 Trash Haulers.

INFORMATION
II.A Transportation/Processing;
II.C Act 78 Summary.

RESOURCES
C.4 General.

BACKGROUND
Because landfill space is becoming scarce in all communities and disposal costs are rising, people need to find new solutions which won't harm the environment. Some people believe that the ocean is big enough to handle the garbage without polluting it. People are now discovering that this is not true, that "nowhere is away," and that they must find other ways to dispose of their waste.

LEADING QUESTION
When we throw things away, where do they go?

PROCEDURE
1. Sing this song with your class to the tune of *My Bonnie Lies Over the Ocean.*

MY GARBAGE FLOATS OVER THE OCEAN

My garbage floats in the ocean.
My garbage floats in the sea.
My garbage floats in the ocean,
My garbage comes back to me.
Come back, come back, come back my garbage to me...

2. Afterwards, discuss with them how communities are running out of landfill space. Brainstorm solutions.

EVALUATION
In what ways does the garbage come back? How can these communities solve their landfill space problem?

EXTENSIONS
A. Discuss the issue of garbage on barges looking for a place to go.

B. Take the class out to a lake or river shore and look for litter. Identify types.

C. Read and discuss the attached poems, *Everywhere is Somewhere* and *The Dirty Water Blues.*

D. Do the following "Litter In A Lake" experiment.

E. Take a field trip ot a waste treatment and water treatment plant.

Vocabulary: pollution, solid waste, garbage.

Name: **Date:**

Litter In A Lake Experiment

MATERIALS NEEDED

One large glass jar, small pieces of typical litter items such as fruit peelings, iron, glass, paper, plastic wrap, styrofoam, aluminum, lid from a tin can, fabric, etc.

DIRECTIONS

Fill the glass jar with water and add the litter ingredients. Let stand and observe every day for two weeks.

What happened to the water?

What happened to the pieces of litter?

Would you want to swim in water like that? Why or why not?

What might happen to plants and animals who lived in the water?

Is the ocean big enough to take all our garbage without poisoning the creatures who live in it?

Name:

Date:

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The Dirty Water Blues

Pure water gurgles
and splashes along
until pollution
flows into the song:
oil
tar,
paint,
dye,
mud and muck
come splashing by.
Cans,
jars,
bottles,
cars.
Old shoes, old news--
that's the dirty water blues.
Sweet, fresh water
rolls away from this song,
while dirt and pollution
keep flowing along
and along,
and along...

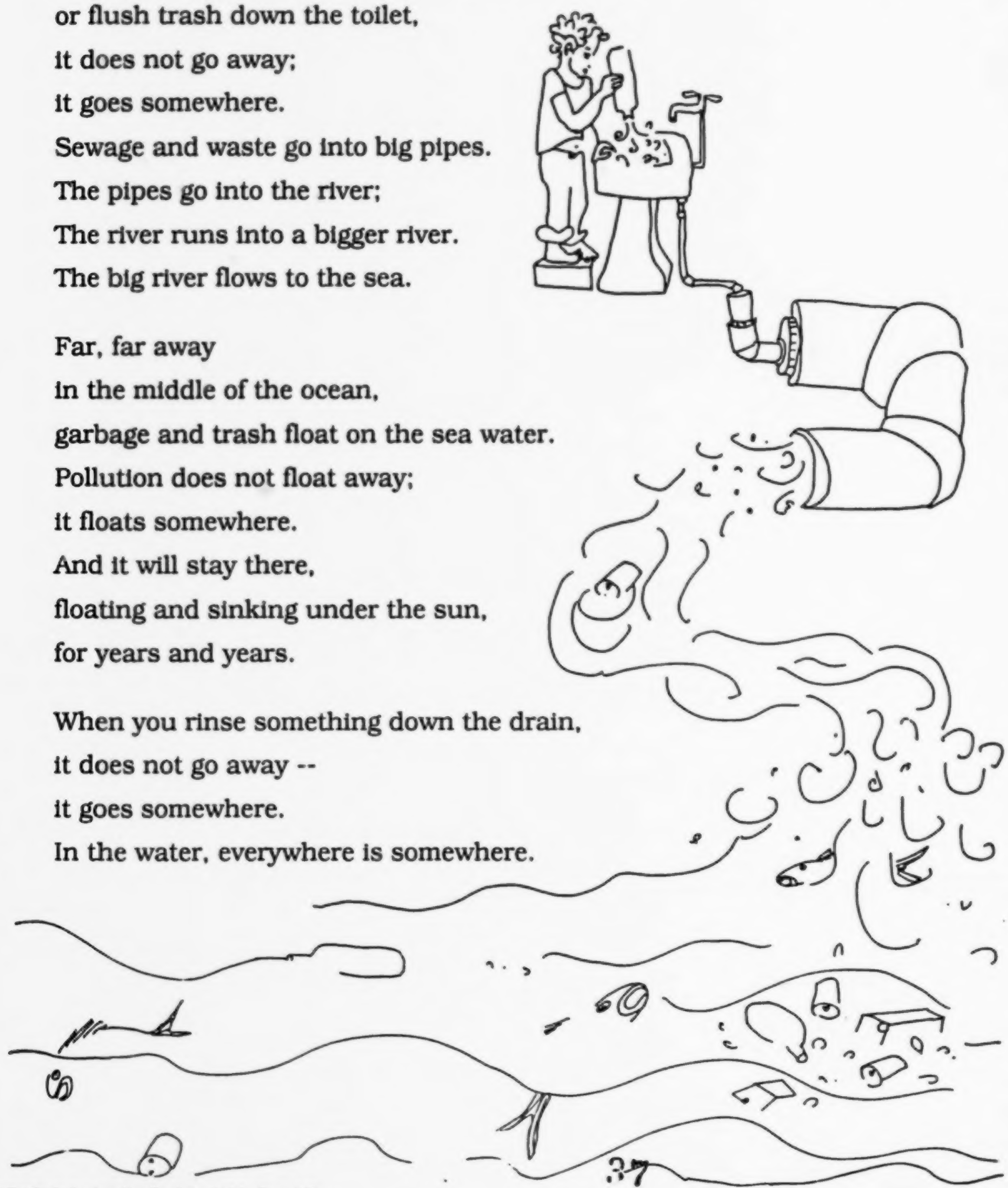
Name: **Date:**

Everywhere Is Somewhere

When you rinse garbage down the drain of a sink,
or flush trash down the toilet,
it does not go away;
it goes somewhere.
Sewage and waste go into big pipes.
The pipes go into the river;
The river runs into a bigger river.
The big river flows to the sea.

Far, far away
in the middle of the ocean,
garbage and trash float on the sea water.
Pollution does not float away;
it floats somewhere.
And it will stay there,
floating and sinking under the sun,
for years and years.

When you rinse something down the drain,
it does not go away --
it goes somewhere.
In the water, everywhere is somewhere.



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LITTER GARDEN

K-3 ● II.A.3

Concept
Littering, decomposition, human-made and natural objects.

Objectives
Students will compare decomposition rates of different objects and will discuss the effects of littering on the environment.

Method
Students will place objects in soil, add water, and record results over time.

Materials
Two 6" deep waterproof trays; small pieces of several different solid waste test samples (glass, rubber band, paper, wool, nylon, etc.);soil (not potting soil); water spray bottle.

Subject
Science.

Skills
Predicting, observing, recording and interpreting data.

Time
40 minutes to start, 40 minutes at end, minutes each day in between for two months.

Resources
Enduring Litter handout, (Information Section II.A.3); Dare Wright, *Edith and Little Bear Lend A Hand*, Norah Smaridge, *The Dead Tree.*

AVR Guide Resources

PARALLEL ACTIVITIES

4-6 ● II.A.2 Landfills;
7-8 ● II.B.1 Mini-Landfills;
9-12 ● II.B.1 New Landfills.

INFORMATION

II.A.3 Litter;
II.B.2 Landfills.

RESOURCES

A.5 Landfills;
C.4 General.

BACKGROUND
Much of the packaging we use today, though convenient and useful for a very short time, causes environmental problems because it is not biodegradable. Nature cannot break it down or use it again, and some substances poison the environment. The varying decomposition rates of human-made and natural materials are highly visible in litter. By taking a closer look at what comprises our "litter stream," we can begin to understand and change some harmful producing, using, and disposal habits.

LEADING QUESTION
What happens to our trash after we throw it out?

PROCEDURE

1. Collect samples of litter. Review the concept of decomposition and the difference between natural and human-made materials. (See K-3 ● I.A.2 LITTER WALK.) Discuss littering and decomposition. Which kinds of materials do you think will decompose and which will not? Make predictions. (Students can complete the worksheet.)

2. Add a two-inch layer of soil. Arrange the samples leaving room between each one. Put a marker in the soil identifying what is in each spot. Cover the samples with two more inches of soil and sprinkle with enough water to make it moist. Add a little water daily.

3. Uncover the samples periodically and record what has happened to each one. Discuss the results over a two-month period.

OPTION: Bury natural materials in one box and human-made in another. When the experiment is finished, the two containers of soil can be used to grow seeds. Is there a difference in the rate of growth?

EVALUATION
How are the results important to how we handle waste?Were the predictions accurate? What does this teach us about littering? What about landfills?

EXTENSIONS

A. Discuss decomposition at landfills.

B. Create a class compost and use both compost material and litter garden soil to make a real garden. Test the effects of the different soils on plant growth.

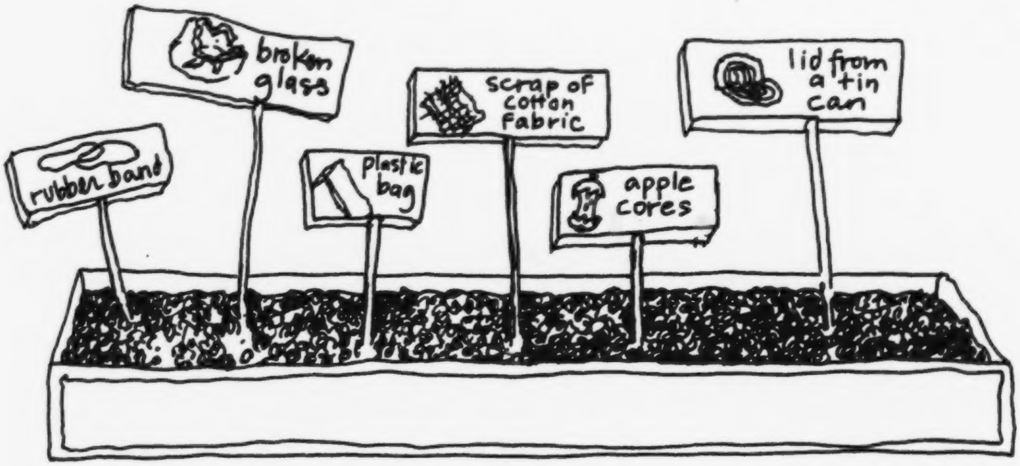
C. Make a time-line or bar graph with student drawings of decomposition rates.

D. Draw pictures of different litter objects; sequence with numbers which will decompose first.

Vocabulary: decomposition, litter, natural, human-made, environment, biodegradable.

LITTER GARDEN

Name: **Date:**



1. Which objects do you think will decompose first?

2. Which will take the longest to decompose?

3. Which might never decompose?

4. Which will be the best for the soil?

5. Which might harm the soil?

EGG CARTONS

K-3 ● III.A.

Concepts
Some packaging is better for the environment than others.

Objectives
Students will recognize that certain products entering the waste stream are more harmful to the environment than others, and that they can make a difference by carefully choosing what they use.

Method
Students will compare styrofoam and paper egg cartons and will reuse both items in craft projects.

Materials
Egg cartons (each student should bring one from home).

Subjects
Art, Social Studies, Health.

Skills
Analyzing, comparing.

Time
One class period.

Resources
Carolyn Jabs, *RE/USES.*

AVR Guide Resources

PARALLEL ACTIVITIES

4-6 ● III.A.1 Pondering Packaging;
7-8 ● III.A.1 Packaging Design.

INFORMATION

I.A.5 Components of the Waste Stream;
I.A.7 Packaging;
III.A Redesign and Reuse.

RESOURCES

B.4 Industry Associations;
C.8 Plastics and Packaging.

BACKGROUND

Paper egg cartons are made from waste paper which is turned back into pulp and formed into the new egg carton shape. Styrofoam egg cartons are made from non-renewable fossil fuels. Styrofoam is a trade name for polystyrene, a plastic which comprises about 12% of the almost two million tons of plastic packaging Americans use each year. Polystyrene is used to make insulated disposable cups, housewares, fast food containers, and packing material. It is not easily recycled, most of it ending up in our landfills, along roadsides, or water ways. When we use and throw out plastic we waste the valuable petroleum which was used to make it.

LEADING QUESTION

Is some packaging better than others?

PROCEDURE

1. Divide children into small groups. Give each group a styrofoam carton and each a paper carton. What differences do they notice? Discuss the differences that we don't immediately notice. (One is made from non-renewable resources and one is made from renewable resources. One has already been recycled and one was made from virgin material.)

2. Discuss what happens to the egg cartons when we throw them out. (One can be recycled and one cannot. One is biodegradable and one is not.)

3. Brainstorm ways to reuse the egg cartons. (jewelry boxes, holiday ornaments, etc.) Explain that when we make crafts, we often combine different recyclables into a form which is not recyclable (like composite packaging). Discuss ways to avoid this.

4. Students can make permanent decorative or functional items from the styrofoam containers, combining other non-recyclable materials with them. The paper egg cartons should be reused in ways that will not preclude their being recycled. For instance, as seed planters which can be buried in the ground and will decompose.

EVALUATION

Which type of egg carton should we use? From what kind of paper are paper egg cartons made? From what non-renewable natural resources are styrofoam egg cartons made?

EXTENSIONS

A. Recycle the egg cartons into planting cups.

B. Make a collage or display of nature's packaging.

C. Children make a list of choices they make on a daily basis.

Vocabulary: choice, reusable, recyclable, environment, styrofoam.

EGG CARTONS

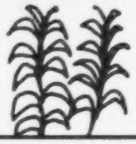
K-3 ● III.A.1

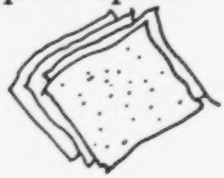
Name: **Date:**

We can make choices every day to help protect our environment.

Circle the picture of the item you would choose to use.

Write the name of the resource used to make it underneath the picture.

OIL	*PLANTS*	*ANIMALS*	*SAND*
			

1.	Paper Napkin 	Cloth Napkin
2.	Paper Cup 	Plastic Cup
3.	Plastic Milk Jug 	Cardboard Milk Carton
4.	Ice Cream Cone 	Ice Cream In A Cup With A Spoon
5.	Ketchup In A Plastic Bottle 	Ketchup In A Glass Bottle

HOW CAN WE REUSE THINGS TO MAKE LESS WASTE?

YESTERDAY'S PAPER

K-3 ● III.A.2

Concept
Reusing materials helps conserve resources and landfill space.

Objective
Students will use brainstorming skills to look at different uses for things we normally throw away.

Method
Students will read a poem and make something new from an old box.

Materials
Large boxes, junque supply box, paint, markers.

Subjects
Social Studies, Art, Language Arts.

Skills
Brainstorming, experimenting, cooperating, fine motor development, divergent thinking.

Time
30 minutes, ongoing reuse projects.

Sources
Pamela Ahearn, East Corinth Elementary; Jack Prelutsky, *Read Aloud Rhymes For The Very Young.*

Resources
Carolyn Jabs, *RE/USES*; Robin Simons, *Recyclopedia*; Bob Graham, *The Junk Book*; Betsy Pflug, *You Can*; *Christina Katerina and The Box*, Holt Basal (2nd grade level story about a girl using a box in different ways).

AVR Guide Resources

PARALLEL ACTIVITIES

K-3 ● III.A.3 Trash or Treasure;
4-6 ● III.A.2 Wise Use of Paper.

INFORMATION

III.A Redesign and Reuse;
III.B Recycling.

RESOURCES

C.1.C Reuse Activities.

LEADING QUESTION
What can we make of this box?

PROCEDURE

1. As a choral reading activity, children read, "Johnny." Afterwards, the children can brainstorm more ideas of how a box can be used.

2. As a class project, you may want to assign a theme so that the boxes can be a part of the classroom. If you are working on a "space" unit, you may want them to make space shuttles. If you are working on trains, you may want to make one for the classroom.

EVALUATION
Why is it important to reuse things?

EXTENSIONS

A. Other reuse activities out of cans, plastics, paper, etc.

B. Challenge students to see how long they can keep using (and reusing) one reusable object such as a piece of paper or a plastic bag. Results could be graphed.

C. Decorate an old paper bag as a litter bag for the family car.

YESTERDAY'S PAPER

Yesterday's paper makes a hat,
Or a boat,
Or a plane,
Or a playhouse mat.
Yesterday's paper makes things
Like that—
And a very fine tent
For a sleeping cat.

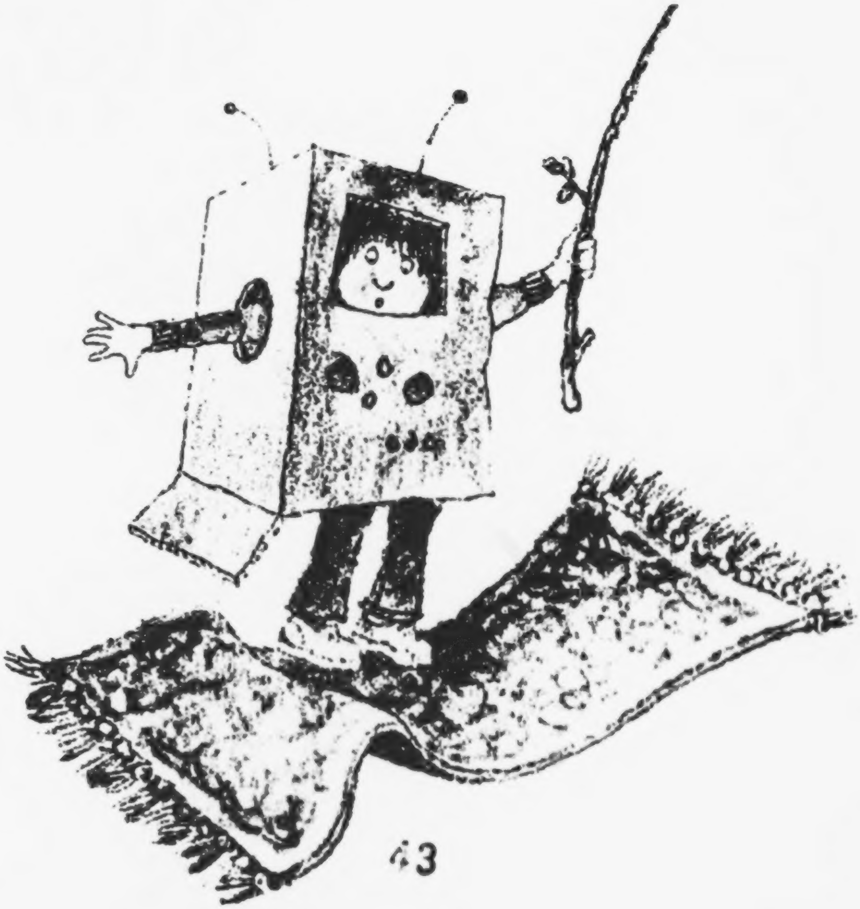
Mabel Watts

Vocabulary: reusing.

JOHNNY

To Johnny a box
is a house
or a car
or a ship
or a train
or a horse.
A stick
is a sword
or a spear
or a cane,
and a carpet
is magic,
of course.

Marci Ridlon



From *Read Aloud Rhymes for the Very Young*, selected by Jack Prelutsky, illustrations (c) 1986 by Marc Brown;
"Johnny" (c) Follett Publishing Company; "Yesterday's Paper" (c) Mabel Watts; published courtesy of Alfred A. Knopf Publishers.

TRASH OR TREASURE? K-3 ● III.A.

Concepts
One person's trash is another person's treasure.

Objective
Students will redefine waste as a resource by identifying what others consider trash as their treasure.

Method
Students will create a class treasure trunk.

Materials
Teacher's own reuse treasure, used objects from student's home, attached poem.

Subjects
Language Arts, Art, Social Studies.

Skills
Divergent thinking, observing, classifying, valuing, experimenting.

Time
Can be set up and added to indefinitely.

Group Size
Whole class.

Sources
Pamela Ahearn, East Corinth Elementary; Shel Silverstein, *Where the Sidewalk Ends*.

Resources
Carolyn Jabs, *Re/Uses*; Robin Simons, *Recyclopedia;* other reuse books (see Resource Section C.1.c.)

AVR Guide Resources

PARALLEL ACTIVITIES
K-3 ● III.A.2 Yesterday's Paper;
4-6 ● III.A.3 New Things From Old.

INFORMATION
III.A Redesign and Reuse;
III.B Recycling.

RESOURCES
C.1.c Reuse Activities.

LEADING QUESTION
Does everybody agree what might be trash and what might be treasure?

PROCEDURE

1. Read the attached poem, *Hector the Collector* by Shel Silverstein. Show the class two examples of reuse objects: a) an object you are reusing for its original purpose and b) one for which you have created a new use.

2. Ask the children to bring from home a treasured object that they have rescued from the trash. It can be something they have reused either for the same or for a new purpose. If they cannot find one, ask them to bring an item for which they have a reuse idea.

3. Have the students show and tell about their objects, describing to the class why they are treasured.

4. Discuss the benefits of reusing things. It is fun and creative. It saves us money because we don't have to buy something new, and we don't have to pay to have it thrown out. It saves space in our landfills. It helps reduce pollution and saves the natural resource which was used to make the original object.

5. Use an old box to create a class treasure trunk. Decorate it with salvaged paper or fabric scraps and fill it with the collected treasures.

EVALUATION

EXTENSIONS

A. Imagine and describe a planet full of creatures who consider the things we throw away as their most treasured possessions.

B. Have each student write a poem or story about an item they treasure that others consider junk.

C. Have a class or school swap day so that people can exchange trash for treasure.

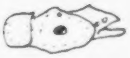
D. Use old greeting cards - to make new ones and as story starters.

Vocabulary: treasure, junk, trash, value.

Hector The Collector

by Shel Silverstein

Hector the Collector
Collected bits of string,
Collected dolls with broken heads
And rusty bells that would not ring.
Pieces out of picture puzzles,
Bent-up nails and ice-cream sticks,
Twists of wires, worn-out tires,
Paper bags and broken bricks.
Old chipped vases, half shoelaces,
Gatlin' guns that wouldn't shoot,
Leaky boats that wouldn't float
And stopped-up horns that wouldn't toot.
Butter knives that had no handles,
Copper keys that fit no locks,
Rings that were too small for fingers,
Dried up leaves and patched-up socks.
Worn-out belts that had no tracks,
Airplane models, broken bottles,
Three-legged chairs and cups with cracks.
Hector the Collector
Loved these things with all his soul-
Loved them more than shining diamonds,
Loved them more than glistenin' gold.
Hector called to all the people,
"Come and share my treasure trunk!"
And all the silly sightless people
Came and looked...and called it junk.



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CYCLES

K-3 ● III.B.

Concept
Nature works in cycles.

Objective
Students will trace the life cycle of a familiar object from production to disposal, and will recognize the difference between disposing of the object and recycling it as a resource.

Method
Students will act out a cycle and draw pictures.

Materials
Paper, crayons or pencils, blackboard and chalk, common object such as a piece of paper or a can; a long piece of string.

Subjects
Art, Language Arts, Social Studies, Science.

Skills
Acting, drawing, sequencing, experimenting.

Time
One class period.

Source
Recyculum.

Resources
Alu Man the Can (video and coloring book); Anne Shanks. *About Garbage and Stuff.*

AVR Guide Resources

PARALLEL ACTIVITIES

4-6 ● III.B.1 Where From,Where To?;

7-8 ● III.B.3 Destination Recycle.

INFORMATION

I.A.5 Components of the Waste Stream; III.B. Recycling.

RESOURCES

C.5 Recycling.

BACKGROUND

Everything we make, use, and throw away originates from and returns to the earth; nature works in cycles. Thinking in cycles can help us to remember that energy, natural resources and money are all used up in bringing everyday objects to us. By reusing and recycling our resources, we can save what would normally be lost in a landfill.

LEADING QUESTION

What happens to things after we throw them out?

PROCEDURE

1. Select an object such as a can or piece of paper. With the class, list all the steps used in bringing that item to us. Then add all the steps required to recycle it.

2. Assign one of the steps to each child. Have the children arrange themselves in the correct order in a circle, each holding onto part of the piece of string.

3. To illustrate the benefits of recycling and resource conservation, remove parts of the cycle. What happens if we send the object to the dump instead of recycling it? What would happen if there were no more resources to start the cycle? Why is it important to keep resources recycling?

OPTIONS: Have the children role play the item, explain the sequence of recycling on a large chart, or make their own recycling chart on paper plates. Children could tell a story about the picture on the paper plate.

EVALUATION

Can we keep taking resources out of the earth forever? Why is it important to recycle?

Vocabulary: cycles, recycling, resources, waste.

EXTENSIONS

A. Roleplay the cycle of a paper plate vs. the cycle of a styrofoam plate (recyclable vs. nonrecyclable).

B. Take the class out to a stream. Mentally trace the flow of water upstream as far as you can. Travel to a spring, or runoff from a rainstorm, from the sky, from clouds, evaporation, ocean, etc. all the way back to downstream from where you sit. Look for a piece of litter nearby and try to do the same.

C. Have each student divide two pieces of paper into four parts, label as follows, and then illustrate.

Recycling

1. MAKING - a picture of the item

2. USING - a picture of the child using it

3. SAVING - separating, storing and bringing to recycling center

4. RECYCLING - making it into something new

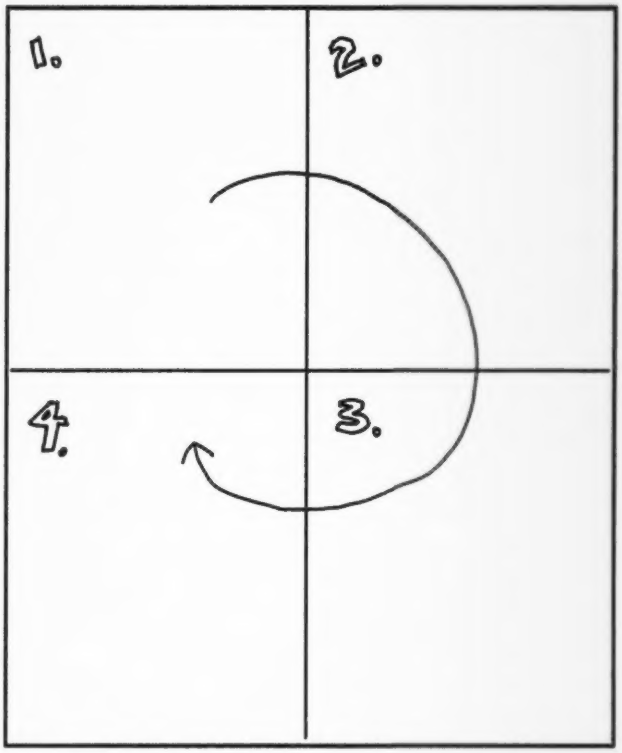
Throwing Away

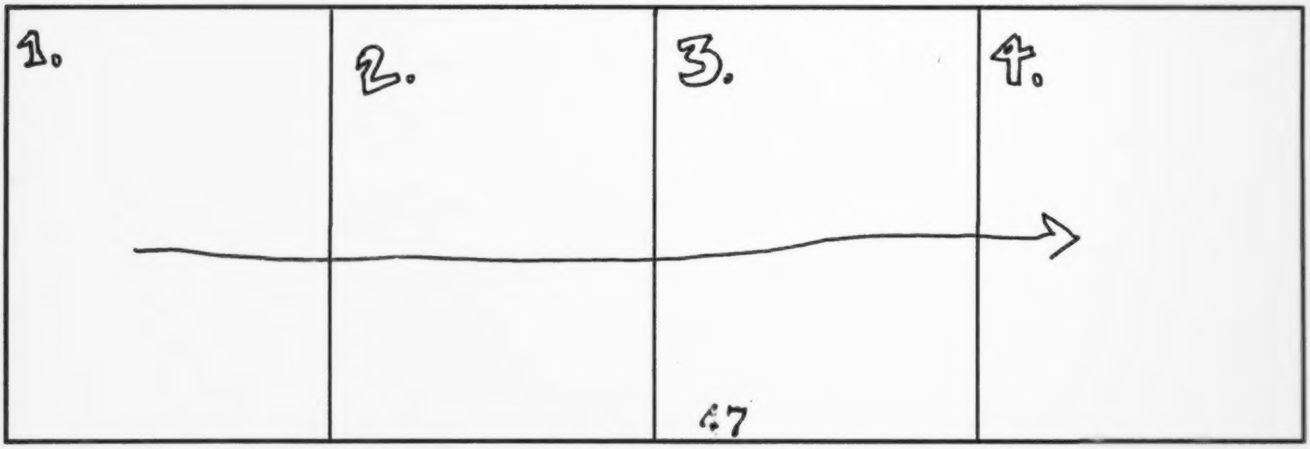
1. MAKING - a picture of the item

2. USING - a picture of the child using it

3. THROWING AWAY - where they throw it away

4. DUMPING - at the landfill





WHAT'S RECYCLABLE? K-3 ● III.B.2

Concept
Some materials are easier to recycle than others.

Objective
Students will be able to distinguish recyclable from non-recyclable materials and will know how to prepare them for recycling.

Method
Students will select pictures from magazines and will sort and prepare materials for recycling.

Materials
Old magazines, magnets, scissors, glue.

Subjects
Social Studies, Science.

Skills
Sorting and classifying, analyzing, experimenting.

Time
Two class periods, ongoing station activities.

Sources
Pamela Ahearn, East Corinth Elementary; *Recyculum.*

Resources
Alu Man The Can. (video and coloring book). Dare Wright, *Edith and Little Bear Lend a Hand;* Ann Zane Shanks, *About Garbage and Stuff.*

AVR Guide Resources

PARALLEL ACTIVITIES

4-6 ● III.B.3 Where To Recycle;
7-8 ● III.B.1 Source Separating;
9-12 ● III.B.2 Collecting and Sorting.

INFORMATION

I.A.5 Components of the Waste Stream; III.B. Recycling.

RESOURCES

C.5 Recycling.

BACKGROUND

Virtually all things could be recycled in one manner or another. But some are more easily recyclable than others. And many objects, while recyclable, may not be collected in our area.

LEADING QUESTION

What objects can be recycled?

PROCEDURE

1. Ask each child to select a picture of an object that is reusable or recyclable from an old magazine. Each child will explain to the class why his or her object is recyclable. Make a collage of the pictures.

2. Recyclable materials include newspaper,corrugated cardboard, ledger paper, steel cans, aluminum, three colors glass (brown, green, clear), plastic milk, water or juice jugs (HDPE),and soda bottles (PET). Demonstrate how to prepare each of the sample materials for recycling and set up a recycling station where children can properly sort the materials.

EVALUATION

What are the easiest materials to recycle?

EXTENSIONS

A. Magnets are pieces of iron or steel which attract other ferrous metal (containing iron or steel). Magnets will not attract aluminum. Have each student demonstrate the use of magnets in telling the difference between aluminum and steel cans. Note other differences between the two, such as weight, presence or lack of seams, ribbing and paper labels.

B. Have students make a "How to Recycle" book to bring home for their families.

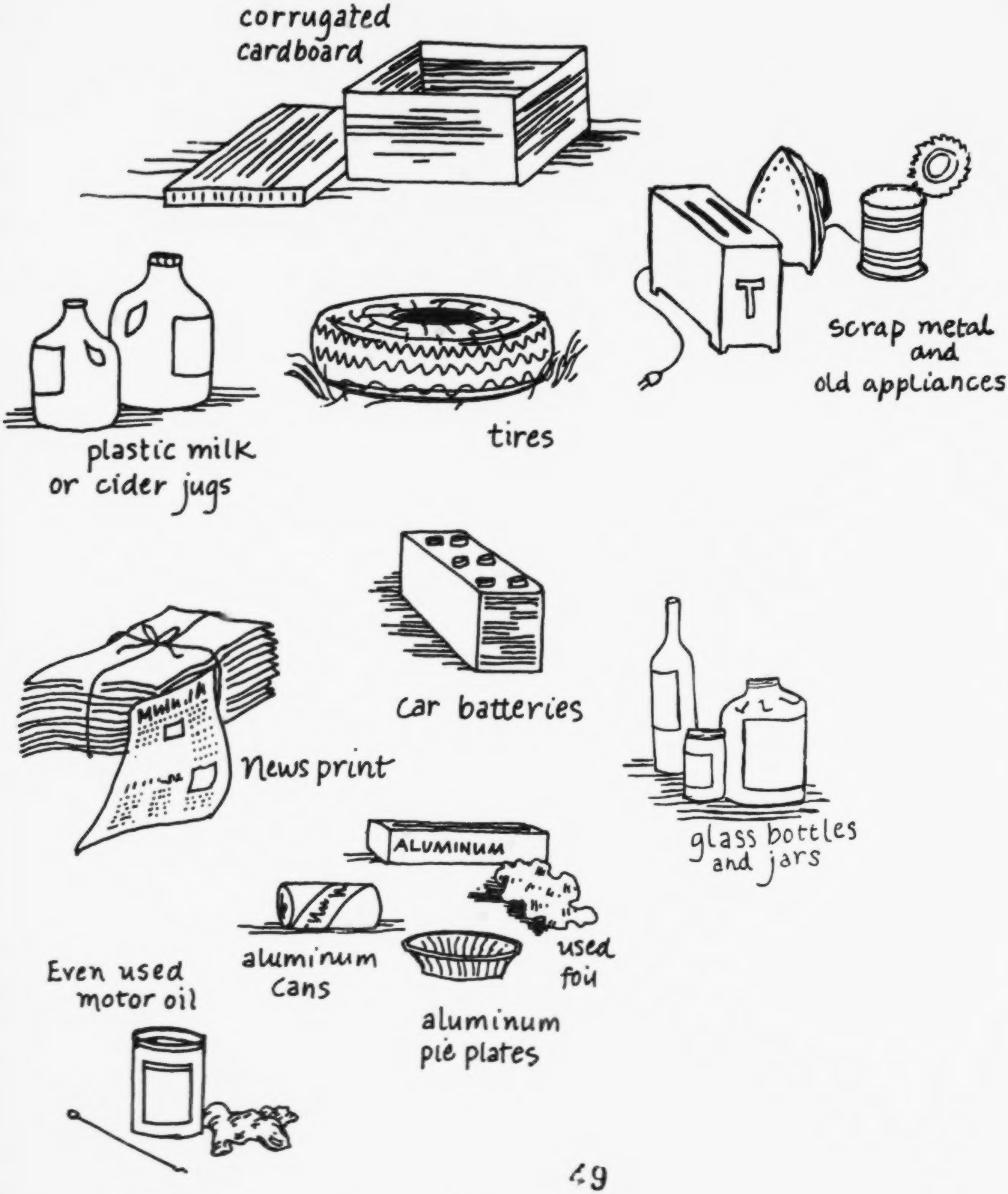
C. Take collected recyclables on a field trip to a recycling center.

D. Older children may play a recycling relay race. Divide class into teams. Each child picks an object from a bag of mixed clean trash and delivers it to a box or bag labelled "nonrecyclable" or with the type of recyclable.

E. Students design a recycling center for their home. See 7-8 O III.B.1 SOURCE SEPARATING.

Vocabulary: magnetism, aluminum, steel, recycle.

WHAT'S RECYCLABLE? K-3 ● III.B.2



BANANA PEEL BLUES

K-3 ● III.C.1

Concepts
Organic waste can be recycled to enrich soil.

Objective
Students will understand the cycles of a compost pile and how it is beneficial.

Method
Students will sing a song and analyze its meaning.

Materials
Chart with words of song on it.

Subjects
Language Arts, Science, Music.

Skills
Sequencing, cause and effect, rhythm, music appreciation.

Time
20 minutes a day for several days.

Source
Pamela Ahearn, U-36 Elementary School, East Corinth.

Resources
Jenepher Lingelbach, *Hands-On Nature.* Vicki Cobb, *Lots of Rot;* Harlow Rockwell, *The Compost Heap;* Alvin Tressalt, *The Dead Tree.*

AVR Guide Resources

PARALLEL ACTIVITIES
4-6 ● III.C.1 Mini-Compost;
7-8 ● III.C.1 Making Good Compost;
9-12 ● III.C.1 Microorganisms;
III.C.2 Effective Fertilizers.

INFORMATION
III.C Composting.

RESOURCES
C.6 Composting.

Banana Peel Blues

Take me out to the compost;
Take me out to the heap.
Grind me up in a food grinder;
I don't care if I'm chopped in to bits,
'Cause it's root root root for the microbes;
If they don't live it's a shame.
For it's 2,4,6 weeks I'm out to the old garden.

LEADING QUESTION

How does composting work?

PROCEDURE

Sing the *Banana Peel Blues* to the tune of *Take Me Out To The Ballgame.* Discuss the sequence of events in the song and how they work to produce humus. Practice the song once a day at a convenient time. Each time the class sings it, they may address a different question about composting.

1. How does the production of humus start the cycle over again?
2. Why is a food grinder beneficial?
3. Why would it be a shame if microbes didn't live?
4. How can we make sure they will thrive?
5. What kinds of things can you compost? (Make a list on the board.)

EVALUATION

When you believe the children know the song, they can unscramble the sentences on the worksheet so that they are in order.

EXTENSIONS

A. Children can illustrate their favorite part of the song.

B. Make a compost pile for the classroom. (See 4-6 ● III.C.1 MINI-COMPOST.)

C. Draw a picture of a compost creature.

Vocabulary: compost, cycles, microbes, humus.

Name: **Date:**

Cut on the lines and paste in order on the space above.

'Cause it's root root root for the microbes:

Take me out to the heap

If they don't live it's a shame.

Take me out to the compost;

Grind me up in the food grinder;

I don't care if I'm chopped into bits.

For it's two, four, six weeks I'm out to the old garden.

Banana Peel Blues

CONTENTS

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  - 1. THEN AND NOW

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- **C. COMPOSTING**
  - 1. MINI-COMPOST

LITTER SEARCH

4-6 ● I.A.1

Concepts
The solid waste stream can be classified into a number of categories.

Objective
Students will develop an awareness of the variety, sources and amount of litter and will be able to classify its elements.

Method
Students will collect and categorize different litter items from around the school, and will dispose of the human-made litter properly.

Materials
Paper bags for each student (preferably reused), newspaper to spread trash out on.

Subjects
Social Studies, Science.

Skills
Classifying, hypothesizing, inferring, observing, graphing.

Time
60 minutes.

Sources
Workshop, *Recyculum*, *Trash Monster*.

AVR Guide Resources
PARALLEL ACTIVITIES

K-3 ● I.A.1 Garbage Bag Recipe;
7-8 ● I.A.2 School Trash Analysis.

INFORMATION

I.A.5 Components of the Waste Stream;
II.A.3 Litter.

RESOURCES

C.2 Further Reading for Students;
C.4 General.

LEADING QUESTION
What kinds of trash do you think we'll find around the school?

PROCEDURE
NOTE: Before beginning this activity, make sure there is enough litter outside.

1. Pass out used bags for collecting litter. Discuss some possible items and where they are likely to be found.

2. Take the class outside. Set the boundaries for the litter search. Caution students on cuts from glass, etc. Litter should be collected in their bags. Set a ten-to-fifteen minute limit for the hunt.

3. Return to the classroom and divide the class into groups of five or so. Combine the group's litter into piles and sort according to categories: 1) glass, 2) metal, 3) paper, 4) plastic, rubber and textiles, 5) food and misc. waste.

4. Graph in a bar graph and discuss the results. In what places was most of the litter found? How did it get there? Why don't people dispose of waste properly? Which items were left alone and why? What percentage can be reused or recycled? What percentage will decompose within two years?

OPTION: Half the class could do this using litter, the other half using trash from the trash can. Compare the two.

EVALUATION
Were the students able to correctly classify the litter items they collected?

Vocabulary: biodegradable, human-made, natural.

LITTER SEARCH

EXTENSIONS

A. Make displays of the different kinds of litter. Separate the litter into renewable and non-renewable resources, natural and human-made objects, bio- and non-biodegradable objects, etc.

B. Make a time-line poster of the biodegradability of trash found, using the "Enduring Litter" chart and pasting pieces of collected trash on the poster.

C. Make litter collages or posters to discourage littering.

D. Design and carry out a behavioral experiment to determine why people litter. Have students offer individually wrapped treats to other children outside of the class and document in what way the subjects dispose of the wrapping: 1) by putting the wrappers in their pockets, 2) putting the wrappers in a nearby trash receptacle, or 3) throwing the wrappers on the ground.

E. Compare litter search results with the results which might be arrived at using a different trash can, i.e. one from the school kitchen, one from home, one from a factory, etc. Assess the amount of waste produced in other classrooms and the lunchroom. Do other classrooms use the other side of paper?

F. Do a classroom trash can sort. Try the same activity a month later to see if students have changed any of their behaviors regarding recycling and the consumption of natural resources.

G. Broaden activity to coordinate with community Green-Up Day activities.

LUNCH BAGS

4-6 ● I.A.2

Concept
Each of us is responsible for the size and composition of the waste stream. Reusing can help reduce waste.

Objective
Students will measure how much lunch waste they produce as individuals and as a class, will categorize the content of their lunch waste, and will identify reusing as a way to reduce solid waste.

Method
Students will examine, classify and record the content of their lunches before and after eating.

Materials
Lunches and lunch remains, worksheets, scales, chart.

Time
Two class periods (before and after lunch).

Subjects
Math, Health, Social Studies, Science.

Skills
Measuring, classifying, recording and analyzing data.

Sources
Lawrence Pringle, *Throwing Things Away; The Great Garbage Machine.*

Resources
Dr. William Rathje (The Garbage Project, University of Arizona): Betty Miles, *Save The Earth.*

AVR Guide Resources
PARALLEL ACTIVITIES
7-8 ● I.A.1 Throwing It All Away;
7-8 I.A.2 School Trash Analysis.
INFORMATION
I.A.5 Components of the Waste Stream.
RESOURCES
C.4 General.

BACKGROUND

Dr. Rathje is an archeologist with the University of Arizona who studies solid waste. "His study reveals that Tucson's residents throw away 15% of their edible food, at an annual cost of $11 to $13 million. Most of this in not in tiny bits but in large, usable amounts, such as whole steaks and half-used packages of soup. Comparing different neighborhoods, the study showed that middle-income people waste more food (and usable tools and appliances) than the poor or rich... Interviews with people in their homes, compared with actual evidence from garbage collected from their neighborhoods, revealed that people throw away much more edible food than they like to admit..."

-- Lawrence Pringle, *Throwing Things Away.*

LEADING QUESTION
How much of your lunch do you eat and how much do you throw away?

PROCEDURE

1. Before lunch, have children examine their lunches and complete the attached worksheet. Each student should record the weight of the lunch on class chart. Compare the different packaging (i.e. baggies, plastic or foil wrap, waxed paper, paper bags), and discuss how much came from nonrenewable and how much from renewable resources. Ask students to bring everything they do not eat and all the wrapping back with them after lunch. Make sure they do not change their eating habits just for this experiment.

2. After lunch, have each student weigh the packaging and food remaining from lunch. Working singly or in groups of four or five add this information to the class chart. Calculate the percentage of lunch actually consumed and the percentage of organic waste. If working in groups, have each summarize their findings and report to the class.

3. Find a class total and calculate the waste generated by the class in a week, a month, the school year. Multiply times the number of classes in the school to get an approximate number for the school lunch waste. There are about 90,000 students in Vermont schools. Using an individual average from the class total, have the students figure out how much school lunch waste is generated in Vermont each year.

4. Discuss the types of waste produced. What are similarities between individuals in the groups? Which category had the most waste? Discuss ways to reduce the amount of waste produced. How might some of the waste be reused or recycled?

EVALUATION
Each student should be able to correctly measure, categorize and chart his or her lunch waste and identify potentials for reduction in waste through recycling or reuse.

Vocabulary: organic, renewable, non-renewable, waste generation.

LUNCH BAGS

EXTENSIONS

A. Discuss the pros and cons of using plastic vs. paper grocery bags. Paper bags are made from a recycled renewable resource and can be reused and recycled again. A paper bag is biodegradable. Plastic bags are made from a non-renewable resource, can be reused, but are not recyclable. Most plastics are not biodegradable, and when burned, can emit toxic fumes. Which bags are better to use? Encourage students to act in response to their opinions by making conscious choices and requesting the bag they think least harmful to the environment at check out counters.

B. Discuss alternatives to requesting either bag at the check-out counter. For small purchases, choose not to use a bag at all. Bring back and reuse the bag you got from your last grocery trip. Make a permanent grocery bag from durable fabric which can be refilled and reused every trip to the grocery store.

C. Begin a class or school composting program to recycle organic lunch wastes.

D. Discuss the use of reusable lunch boxes, sandwich containers, thermos bottles, etc. to help reduce the amount of solid waste produced by carrying lunch to school or work.

LUNCH BAGS 4-6 ● I.A.2

Name: **Date:**

SCHOOL LUNCH WASTE

ITEM	FOOD	NON FOOD		
		made of	renewable	nonrenewable
sample:				

1. Which category had the most waste?
2. Which had the least?
3. Which types of waste were reusable?
4. Which types of waste were recyclable?
5. What can we change to reduce our lunch waste?

LUNCH BAGS

4-6 ● I.A.2

Name: **Date:**

"No Bag, Please"

a one-hour project

Everyone knows that when you save paper, you save some trees that would have to be cut down to make new paper.

Everyone knows this. But you can find out how hard it is for people to get used to saving paper.

Try this project when you are going shopping. Take a big shopping bag with you to put things in. When you pay for something watch carefully. Does the person at the counter start to put it in a bag for you?

If this happens, say "I don't need a bag, thanks."

Then see how the store person acts. Surprised? Pleased? A little bit angry? Confused?

Then see how you feel. Ordinary? Embarrassed? Good?

It is sometimes easier to try new ways if you can get other people to try them with you. Maybe a friend or two from school would try the "no bag, please" experiment with you.

THE STORY OF...

4-6 ● I.A.3

Concept
Some packaging is better for the environment than others.

Objective
Students will gain a better understanding of the resources which make up some typical packages and potential ways to reuse or recycle them.

Method
Students will answer questions about different containers.

Materials
Aluminum can, plastic bag, cardboard box, steel can, glass bottle, attached "The Story of..."

Subjects
Social Studies, Language Arts.

Skills
Researching, reporting, analyzing, drawing conclusions.

Time
Several class periods.

Sources
Workshop, *Recyculum*.

Resources
Glass Packaging Institute; Reynolds Aluminum Company; The Aluminum Association; American Paper Institute; Encyclopedias. Vicki Cobb, *The Secret Life of School Supplies*; Norman Smith, *If It Shines, Clangs, and Bends, Its Metal*; Suzanne Hilton, How Do *They Get Rid Of It?*

AVR Guide Resources
PARALLEL ACTIVITIES
K-3 ● I.A.3 Gum Wrappers;
7-8 ● I.A.3 Potato Cakes;
9-12 ● I.A.2Packaging Preferences.

INFORMATION
I.A.5 Components of the Waste Stream;
A.7 Packaging.

RESOURCES
A.10 Vermont Businesses;
C.8 Plastics and Packaging;
B.4 Industry Associations.

LEADING QUESTION
What kind of container do you think is best for the environment?

PROCEDURE

1. Divide the class into five groups, each group representing one of the following common types of packaging:

   a. aluminum can
   b. plastic bag
   c. cardboard box
   d. tin can
   e. glass bottle

2. Each group will do some research into their packaging type, using the attached "The Story of..." questions as guidelines for inquiry.

3. After completing their research, each group will report to the rest of the class what they have discovered about their type of packaging.

4. As a class, compare reports, discuss advantages and disadvantages of each type of container and decide which are most desirable.

5. Teacher hold up examples of mixed packaging. Class discuss problems caused by mixed packaging.
(See 4-6 ● III.A.1 PONDERING PACKAGING.)

EVALUATION
Was the student able to report about a packaging type?

EXTENSIONS

A. Make an effort to use reusable containers for your lunch.

B. Collect all the packaging from products you buy for a period of time. Could you have made wiser choices in your product selection? Could the manufacturer have made wiser choices in the package production?

C. Design an environmentally sound package for a product.

Vocabulary: biodegradable, raw materials, natural resources, reuse, recycle, pollution, processing, reuse.

THE STORY OF... 4-6 ● I.A.3

Name: **Date:**

I am a(an)______________ container.

Please tell my story by finding answers to the following questions:

1. Describe me.

2. What are some of the things I am used for?

3. What am I made of?

4. What natural resource do I come from?

5. Are large amounts of my raw materials available?

6. How does it affect the earth when companies extract my raw materials are taken?

7. Does it take a large amount of energy to produce me?

8. Am I thrown away after I am used?

9. Am I biodegradable? Am I photodegradable?

10. Do I disintegrate if I am thrown into a river, lake or ocean? If so, by what chemical/biological means do I disintegrate?

11. What are some ways in which I could be re-used?

12. Can I be recycled? Am I recycled? Where am I recycled?

13. What happens to me when I am recycled?

14. Who is responsible for disposing of me?

60

15. Who pays the cost for disposal?

16. Do you think I am a good container? Why or why not?

WHAT KIND OF WASTE AM I? 4-6 ● I.B.

Concept
The earth is the source of everything we make, use and throw away.

Objective
Students will review different characteristics of waste.

Method
Students will play a game of twenty questions.

Materials
Aluminum can, glass bottle, paper napkin, fruit peel, plastic bag, other trash objects as needed (avoid composite packaging).

Subjects
Language Arts, Science.

Skills
Convergent thinking (set-theory), critical thinking.

Time
Full period to introduce vocabulary; 10-20 minutes for each guessing game.

AVR Guide Resources

PARALLEL ACTIVITIES

K-3 ● I.B.1 Machine;
9-12 ● I.A.1 Sources of Waste.

INFORMATION

I.A The Solid Waste Stream;
I.B Waste and natural resources.

RESOURCES

C.1.d Environmental Education;
C.4 General.

BACKGROUND
This activity illustrates that the earth is the source of everything we make, use, and throw away. Through the use of classifying skills, the different properties of natural and human-made objects will be reviewed.

LEADING QUESTION
Name one thing we throw away that didn't come from the earth.

PROCEDURE
1. Review vocabulary and categories of waste that will occur in the guessing game. A bulletin board is suggested.

2. Without letting the class see what you are doing, put one of the trash objects in a brown paper bag. Show the contents to one student, then set the bag aside.

3. The class will then begin asking the student questions to determine what is in the bag. Some suggested questions are as follows:

Do I come from the earth? (There's one trick here - a meteorite) Am I made from a renewable resource? A nonrenewable resource? Am I made by a person? Am I made from minerals, fossil fuels, etc. Am I made from animals or plants? Am I biodegradable? Am I packaging? Am I a container? Do I contain food? Am I recyclable? Am I compostable?

When the identity of the object has been determined, have the student pin the object on the resource tree display.

4. Repeat the activity until all the trash objects have been identified. (The resource tree display can be left intact with new objects added to it each day as a continuing review of concepts.)

OPTION: Make a resource tree display, (see handout) and have students ask questions to show where their piece of waste belongs on the display.

EVALUATION
Students should be able to differentiate between natural and human-made materials, packaging and non-packaging items, animals, plants and minerals, renewable and non-renewable resources, and be able to identify compostable and recyclable materials.

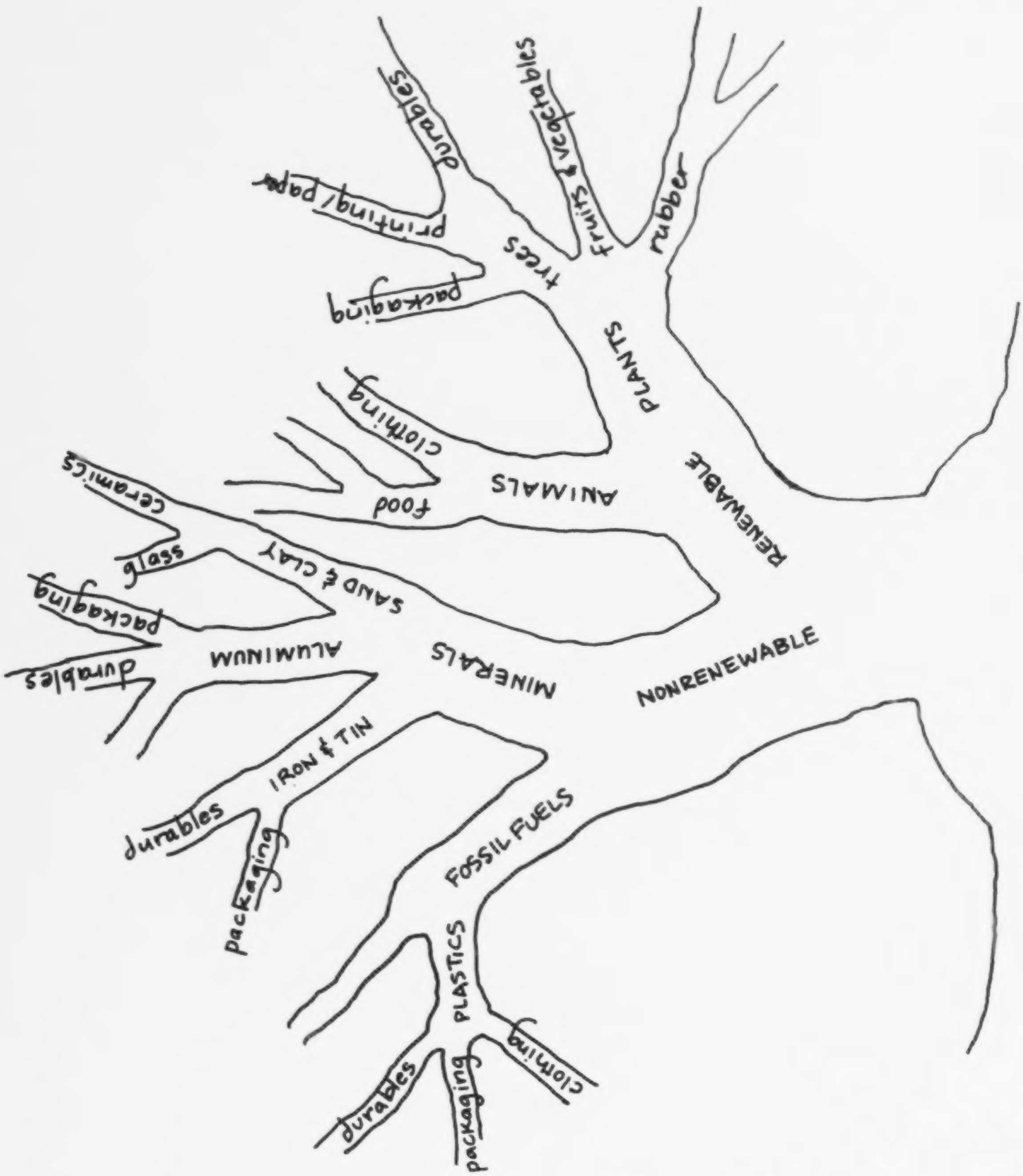
EXTENSIONS
A. Make posters, collages or displays of packaging examples from each of the following areas: natural, human-made, from nonrenewable resources, from renewable resources, biodegradable, non-biodegradable.

B. Have students trace the life history of a common trash object. (e.g. chicken bone-chicken-grain-earth) Did it come from a renewable or nonrenewable resource?

Vocabulary: natural resources, renewable, human-made, containers, compost, biodegradable, recyclabl

Resource Tree Display

The earth is the source of everything we make, use and throw away.



THE LORAX

4-6 ● I.B.2

Concept
We all contribute to the solid waste problem, and we are all responsible for helping to solve it.

Objective
Students will explore the impact of humans on natural systems and will be able to draw conclusions and make predictions about the environmental impact of certain behaviors.

Method
Students will read, listen to, or watch *The Lorax* by Dr. Seuss.

Materials
The Lorax by Dr. Seuss (book or film).

Subjects
Language Arts, Science, Social Studies.

Skills
Reading, writing, listening, predicting, drawing conclusions, problem-solving.

Time
45 minutes.

Source
The Lorax by Dr. Seuss, Copyright 1971 by Dr. Seuss and A.S. Geisel, Random House, Inc.; *Oscar's Options.*

Resources
Shel Silverstein, *The Giving Tree.*

AVR Guide Resources

PARALLEL ACTIVITIES

7-8 ● I.B.1 Resource Protection Game;

9-12 ● I.B.1 Nonrenewable Resources.

INFORMATION

I.B Waste and Natural Resources.

RESOURCES

A.11 Environmental Education;

C.1.d Environmental Education.

LEADING QUESTION
What are some of the consequences of our throw-away habits?

PROCEDURE

1. Read the book or watch the video of *The Lorax.*

2. Discuss the following questions or have the students complete the worksheet. How did each step of the Once-ler's developing business destroy a piece of the ecosystem until the entire system ceased to function? Why was the Super Axe Hacker invented? Why did The Once-ler ignore the Lorax's warnings? What happened to the Lorax? What did the Lorax's message *"UNLESS"* mean?

EXTENSIONS

A. Have the children write poems about real forests and the wildlife which inhabit them. How can they help preserve these natural resources?

B. Draw before and after pictures of the Truffula-tree forest.

C. Have the children create a collage of thneeds (things we think we need) from magazine pictures.

D. Create ads for Natural Resources, modeled after the Once-ler's advertisement for the Thneed:

> *"A Thneed's a Fine-Something-That-All-People-Need.*
> *It's a shirt. It's a sock. It's a glove. It's a hat.*
> *But it has other uses. Yes, far beyond that.*
> *You can use it for carpets. For pillows! For sheets!*
> *Or curtains! Or covers for bicycle seats."*

E. The Lorax spoke for trees "for trees have no tongues". What would you choose to speak for, and what would you say? Plan a one minute talk on behalf of something which cannot speak for itself.

F. Identify and research real-life examples of the following items in the story: Swomee-Swans, Truffula Trees, Brown Bar-ba-loots, Humming Fish, Thneeds, Onceler, Super-Axe-Hacker, Smogulous Smoke, Gluppity-Glupp, Schloppity-Schlopp. (For instance, a real-life example of Truffula Trees is tropical rainforests.)

G. Put on a play of The Lorax.

Vocabulary: natural resources, ecosystem, environmental impact, natural systems.

Name: **Date:**

1. Why did the Once-ler cut down the Truffula trees?

2. Why do the Brown Bar-ba-loots have to leave?

3. What kinds of problems does the thneed factory cause for the environment? Name at least three.

4. What happens to the Once-ler when there are no more Truffula trees?

5. What happens to the Lorax?

6. Is bigger always better? Give an example to back up your opinion.

7. A "Thneed" is defined as a fine thing that everyone thinks they need. What are some examples of thneeds - things that we think we need?

8. If you were the Once-ler, what would you have done differently to protect the environment?

9. What do YOU think the Lorax's message "UNLESS" means?

HOW HAS SOLID WASTE CHANGED OVER TIME?

THEN AND NOW

4-6 ● I.C.1

Concept
What we throw away has changed with technological advances, increased wealth and changes in lifestyle.

Objective
Students will be able to describe ways in which changing domestic habits have intensified human impact on the environment.

Method
Students will compare present and past lifestyles.

Materials
Pictures, artifacts, history resources.

Subjects
Social Studies, Home Economics, Language Arts.

Skill
Thinking, researching, comparing, analyzing.

Time
One class discussion (outside class research time optional).

Sources
Project Learning Tree; Herbert Girardet, *Blueprint for a Green Planet*.

Resources
Shelburne Museum, local museums and historical societies, local libraries, antique shops, old farm dumps, etc.

AVR Guide Resources
PARALLEL ACTIVITIES

K-3 ● I.C.1 Grandparent's Toys;
7-8 ● I.C.1 Trash Timeline;
9-12 ● I.C.3 The Dump Ground.

INFORMATION

I.C Waste and Society.

BACKGROUND

Anyone who has ever excavated an old country garbage dump - in order to turn the site into a rose garden perhaps, or to build a shell - will probably have been interested in what was in it. All you will usually find in such dumps are heel irons (those horse-shoe shaped irons that farming men nailed to their boots), the occasional decayed old boot itself, old enameled sauce pans with holes in them, bits of pottery, the almost completely worn-out remnants of sickles, or scythes, or spade blades, and in the upper horizons of the heap, maybe some broken bottles.

And that will be it: decades of garbage in just one small pile. Now there were not trash collections in those days - people had to dispose of their own garbage, so these dumps contained everything that was thrown away. But all organic material, except leather, went to the pig, or if there was no pig, to the compost heap. Of real garbage, of the kind we produce today, there hardly was any!

-- John Seymour and Herbert Girardet, 1987.

LEADING QUESTIONS

How have our lifestyles changed in the past one hundred year? How have these changes affected our waste stream?

PROCEDURE

1. Ask the students to make a list of the items they use every day. (kitchen appliances, bathroom conveniences, travel methods, types of clothing, food, etc.)

2. Have each student pick one item from the list and research its equivalent from a hundred or two hundred year ago. When information, pictures and artifacts are assembled, have students complete the worksheet.

3. As a class discuss differences of times in the two age groups. How do these differences affect our solid waste crisis?

EXTENSION

A. Take a class field trip to an old local farm dump and excavate, looking for artifacts. Piece together the evidence collected to determine when the dump was last used. Make a lifestyles display from the finds, comparing them with present day equivalents.

B. Invent an alternative to a modern convenience which would not use any nonrenewable resources to operate, would last a long time, and would not adversely effect the environment when its useful life was over.

C. Interview older folk in the community to see what they have to say about life before modern conveniences.

D. Write an essay describing how one or several events from the Trash Time Line (Information Section I.C.2) have caused changes in our environment.

Vocabulary: technology, lifestyles, antiques, natural resources, nonrenewable resource.

THEN AND NOW

Name: **Date:**

Item:
Antique Predecessors:

1. Consider the following characteristics of each object:
    a. Is it made from natural or synthetic components?
        NOW:
        THEN:
    b. Is it made from renewable or nonrenewable resources?
        NOW:
        THEN:
    c. Is it labor saving or labor intensive?
        NOW:
        THEN:
    d. Does it use energy from renewable or nonrenewable resources to operate?
        NOW:
        THEN:
    e. Does it last a long time or is it disposed of quickly?
        NOW:
        THEN:
    f. Is it hand-crafted or mass-produced?
        NOW:
        THEN:
    g. Is it something you wouldn't want to have to do without or something you wouldn't mind giving up?
        NOW:
        THEN:
    h. Is it nonbiodegradable or biodegradable?
        NOW:
        THEN:
    i. Is it nontoxic or does it contain hazardous substances?
        NOW:
        THEN:
    j. Is it necessary for survival or a convenience?
        NOW:
        THEN:

2. List some "luxuries" from the past which are considered necessities today.

3. What changes in lifestyle would result from the following:
    a. loss of a nonrenewable resource

    b. drastic increase in the price of nonrenewable fuel

    c. irreparable damage to a renewable resource (e.g. groundwater contamination, depletion of forest reserves, animal extinction)

HAULING IT AWAY

4-6 ● II.A.1

Concept
Collecting and transporting trash is expensive, and we are running out of places to take it.

Objective
Students will understand that their trash has to go somewhere, that there are limited disposal options, and will understand some of the problems of managing so much waste.

Method
Students will interview school custodians, trash collectors, school business personnel, waste hauling businesses, recyclers and town officials.

Materials
Town, country, state maps.

Subjects
Language Arts, Math, Social Studies.

Skills
Interviewing, mapping and estimating.

Time
Time prior to interview to develop questions.

Resources
Local waste haulers, school custodian, school business office, town clerk, local recyclers.

AVR Guide Resources
PARALLEL ACTIVITIES
K-3 ● II.A.1 Taking Trash Away;
7-8 ● II.A.3 Trash Haulers.

INFORMATION
II.A Transportation and Processing;
II.C Act 78 Summary.

RESOURCES
C.4 General.

LEADING QUESTION
How much does waste disposal cost?

PROCEDURE
1. Invite the school custodian and business manager to the class. With the class, develop a list of questions to ask, such as: How often is trash picked up? What is the cost of removal? Has that cost changed recently? Why? How much trash is produced each week? What is the composition of the trash?

2. Take a field trip to a transfer station, landfill or recycling center.

3. Find out about local waste hauling businesses.
How many are there? How many residents and businesses do they serve? If possible, ask a local waste hauler to come talk to the class. Some possible questions to ask the waste hauler are: How many trucks do you own/operate? What kind of trucks are they? How much does that kind of equipment cost? Why is the equipment designed the way it is? How many truckloads of trash do you collect each day? How is the refuse measured? in tons or cubic feet? How many houses and or businesses do you collect from? Where is the trash taken and what are the tipping fees there? How many miles do you cover each day? Each year? Would you ever consider operating a recycling curbside service? Why or why not? What would it involve?

4. Interview someone from a voluntary recycling program or a recycling business.

5. On the basis of the interviews, have the class determine the costs involved in collecting and disposing of waste. Include equipment, mileage, salaries, tipping fees, etc. incurred in a waste hauling business.

6. Discuss the reasons waste haulers may or may not be interested in curbside recycling. What added expenses would there be to their businesses? Who would pay these costs? What about recycling programs?

EVALUATION
Students write small group summaries from their interview and report it to class.

EXTENSIONS
A. Determine costs for waste disposal for the school for a year. Determine how much paper and/or organic wastes the school produces and devise a recycling or composting program which will help the school save money by reducing disposal costs.

B. Draw a map of your community showing the route your solid waste travels. Estimate cost per mile.

C. Explore what other communities are doing with their solid waste. In what ways are our problems like or unlike those of other communities?

Vocabulary: trash hauler, collection, disposal, tipping fee, curbside recycling.

HAULING IT AWAY

4-6 ● II.A.1

Name:

Date:

In the space below, draw a picture of a truck designed to pick up recyclables along with the trash.

PLASTIC LITTER

4-6 ● II.A.2

Concept
Plastic litter does not decompose and can be dangerous to aquatic wildlife in both marine and freshwater environments.

Objective
Students will recognize some of the environmental hazards of plastic litter.

Method
Students test the "biodegradability" of paper and plastic litter.

Materials
Two cardboard sixpack containers, two plastic sixpack rings.

Subjects
Science, Social Studies, Language Arts.

Skills
Comparing, experimenting, hypothesizing, problem solving.

Time
One class period to start, ongoing results recording over several weeks or months, one class period to discuss results.

Sources
Aquatic Project Wild; Andre Rouleau, Agency of Natural Resources; *Oscar's Options*.

Resources
Center for Environmental Education, *Plastics in the Ocean: More Than a Litter Problem*; D.H.S. Wehle and Felicia C. Coleman, The Entanglement Network; Vermont Fish and Wildlife Department.

AVR Guide Resources
PARALLEL ACTIVITIES
7-8 ● II.A.1 Waste Walk.
INFORMATION
I.A.5.e Plastic; II.A.3 Litter.
RESOURCES
B.4 Industry Associations;
B.5 Environmental Groups
C.8 Plastics and Packaging.

BACKGROUND
1976 amendments to the Vermont Bottle Bill require all six pack plastic rings to be biodegradable (capable of being broken down by microorganisms into natural particles, ultimately into carbon dioxide and water). But in the Vermont law, biodegradable really means photodegradable, capable of being broken down into smaller pieces by sunlight. The photodegradability of plastic has been tested by exposing it to direct sunlight for long periods of time. Natural conditions rarely imitate those necessary for the photodegradation of plastics.

LEADING QUESTION
Is plastic litter a problem?

PROCEDURE
1. Review the history of the Vermont bottle bill. Discuss the meaning of photodegradable and biodegradable.

2. Conduct this experiment to determine the "biodegradability" of different packaging materials: Tack one cardboard sixpack container to a fence post or other fully sunlit spot, and secure the other to a shady spot, leave in water, or cover partially with wet leaves. Repeat with two plastic "biodegradable" six-pack rings.

3. Check periodically for decomposition. Discuss results. How long did the paper take to decompose? Did any animals or insects help in the process? Did the plastic rings decompose? Was there a difference in the rates of decomposition between sun and shade?

4. Share the attached illustrations and information with students. Discuss the effect of plastics on the environment and their harm especially toward aquatic wildlife, including fish, mammals, birds and reptiles. How might we begin to solve these problems?

EVALUATION
What are two characteristics of plastic that make it harmful to the environment? What are two things you can do to prevent harm to wildlife from plastic litter?

EXTENSIONS
A. After reviewing the different problems caused by litter, play a game of charades. Break the class into groups of two or three. Give each group one of the attached charade cards. Students act out the litter action and then its effect on humans, wildlife and the environment. After each charade has been guessed, the class as a whole discusses possible ways to prevent or solve the problem.

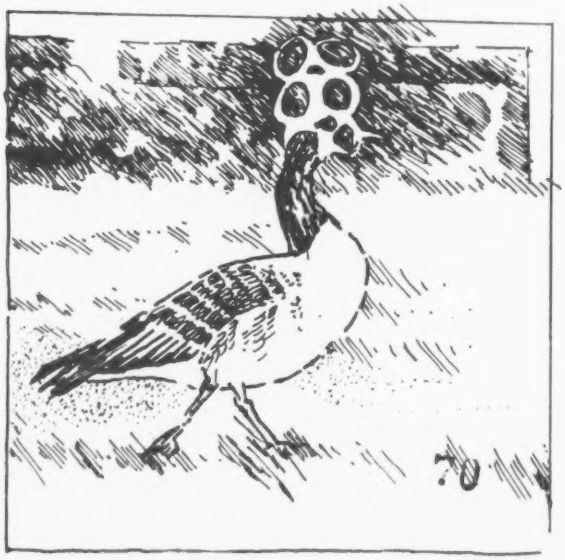
B. Write a story about a wild creature encountering plastic litter.

C. Collect as many different kinds of plastic as you can find. Then answer this question: Why is plastic difficult to recycle?

Vocabulary: litter, plastic, photodegradable, biodegradable, organic.

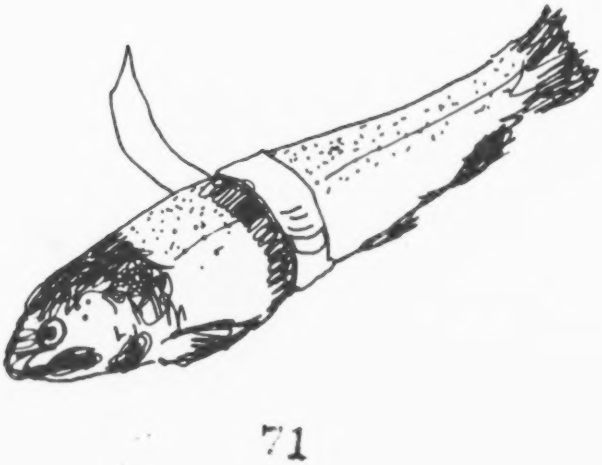
Every year countless numbers of marine animals are found entangled by fishing line. Sea turtles become entangled insnagged line and, unable to break free, they drown. Birds even use discarded line for nesting materials that can create death traps for their young. It's not just fishing line that causes problems. Fish, birds and other animals have been found entangled in plastic rope, nets, and even plastic connector rings used for beverage and motor oil cans. But entanglement is only part of the problem. Some animals including sea turtles, whales and dolphins, even mistake plastic trash for food--a fatal mistake. One sea turtle was found with 590 feet of heavy duty line in its stomach, and several have been found to eat plastic bags and sheeting. [The animals then do not eat because their stomachs are full of plastic, and they starve to death.]

--Kathyrn O'Hara,
Center for Environmental Education, 1988.



The Cousteau Society estimates that six million tons of litter enter the sea each year. Most of this is the product of merchant ships and the practice of dumping garbage in the sea... Commercial fishing fleets are estimated to have lost nearly 300 million pounds of plastic fishing gear in 1975 alone. This plastic netting entangles and kills fish and marine mammals. Scientists estimate that plastics are killing up to a million seabirds and over 100,000 sea mammals a year. Recently plastics have been found in the stomachs of whales, dolphins, fish, birds, and manatees. Leatherback turtles often mistake plastic bags floating in the sea for jellyfish, one of their favorite foods. As plastics accumulate in the intestines of such animals, starvation occurs slowly. Plastic holders for beverage cans, plastic bags, and lost or discarded fishing line can all be damaging to wildlife.

--Aquatic Project Wild



CHARADE CARDS

ACTION: **EFFECT:** **SOLUTION:**	**ACTION**: A person litters a plastic ring from a soda six pack. **EFFECT**: The plastic ring strangles a duck or a fish. **SOLUTION**:
ACTION:A logging company clearcuts a forest. **EFFECT**: There are no more trees left and forest creatures are left homeless. **SOLUTION**:	**ACTION**: Someone changes his or her automobile oil and dumps it on the ground. **EFFECT**: A person or animal drinks contaminated water and becomes sick. **SOLUTION**:
ACTION: A litterer throws a bottle out of a car. **EFFECT**: A person or animal steps on broken glass and cuts its foot. **SOLUTION**:	**ACTION**: A person throws a hot match on a path or roadside. **EFFECT**: A forest fire starts. **SOLUTION**:
ACTION: A farmer sprays pesticides on his potatoes. **EFFECT**: Rain washes the pesticides off into a stream and fish die. **SOLUTION**:	**ACTION**: A person throws a plastic sandwich bag out in the lake. **EFFECT**: A fish thinks the plastic is food, eats it and starves because its digestive track gets blocked. **SOLUTION**:

LANDFILLS

4-6 ● II.B.1

Concepts
Most solid waste is disposed of in landfills, but landfills are filling up and polluting our environment.

Objective
Students will learn how a sanitary landfill is made and operates, and will understand some of the associated pollution problems.

Method
Students will review how a landfill works and will visit a sanitary landfill.

Materials
The Technology of Trash VHS or 16 mm. (free loan from Modern Talking Picture Service 813-541-5763); landfill illustration in Resource Section II.B.

Subjects
Science, Social Studies.

Skills
Observing, recording.

Time
One class period, field trip.

Source
Workshop.

Resources
ANR, *State of Vermont Solid Waste Rules*; local landfills.

AVR Guide Resources
PARALLEL ACTIVITIES

K-3 ● II.A.3 Litter Garden;
7-8 ● II.B.1 Mini-Landfills;
9-12 ● II.B.1 New Landfills;
9-12 ● II.B.2 Methane.

INFORMATION

II.B.2 Landfills;
II.C.2 Solid Waste Plan Summary.

RESOURCES

A.5 Landfills; C.4 General.

BACKGROUND
As the hazards of open dumping have become better known, landfill designs and rules have changed to better protect public health and our environment. The most recent changes in Vermont landfill regulations were made in 1988. There are several operating rules which characterize a sanitary landfill. Open burning is not allowed. Wastes are spread out, compacted and covered frequently with several inches of soil to reduce odor, control litter, insects and rodents, and protect public health. Liners and leachate collection systems are installed to protect ground and surface water from contamination. Fencing helps to control litter and prevent illegal dumping. When the site is finally full, it must be covered with a thicker layer of soil, landscaped and provisions made for the safe escape of methane gas and continued collection of leachate and monitoring of groundwater.

LEADING QUESTION
Do we take our trash to a sanitary landfill or an open dump?

PROCEDURE
1. Explain the differences. Watch a video on how a sanitary landfill works and/or review Information Section II.B.1 Landfills.

2. Is there a landfill in your community? If not, where is the closest one? Is there a transfer station? Take a field trip to alocal landfill. Call ahead and set up a time for your visit. Have students develop a list of questions to ask landfill personnel. (You can use the attached list to guide your investigation.)

EVALUATION
Why are sanitary landfills now required in place of open dumps? How might we reduce our need for landfill space?

EXTENSIONS

A. Design a use for your local landfill when it closes.

B. Make a mini-landfill. See 7-8 ● II.B.1 Mini-Landfills.

Vocabulary: leachate, sanitary landfill, refuse.

Name: **Date:**

VISIT TO A LANDFILL

Can you tell it is a landfill from the road?

Can you see what is happening from the road?

Does the site stand out from the rest of the landscape?

Are there many houses nearby?

What noises do you hear?

What kinds of trash do you see?

What is being done to the refuse?

How many vehicles do you see -- working there? coming and going?

What kinds of vehicles?

What are they used for? How many workers?

Where does the leachate go?

Is it collected?

Can you see or smell methane gas coming from the landfill?

INVESTIGATING INCINERATION

4-6 ● II.B.2

Concept
Incineration as a waste management technique has both benefits and drawbacks.

Objective
Students will consider advantages and disadvantages of waste incineration.

Method
Students will visit a waste incineration plant and be presented the advantages and disadvantages of burning wastes.

Materials
Wall chart.

Subjects
Science, Social Studies, Language Arts.

Skills
Organizing, classifying, valuing, inferring, observing.

Time
Three class periods, field trip.

Source
Workshop; Karen Terry and Lisa Paulsen, UVM.

Resources
Vermont Public Interest Research Group; Claremont Waste-to-Energy Plant (Wheelabrator); Work On Waste, U.S.A.

AVR Guide Resources

PARALLEL ACTIVITIES
7-8 ● II.B.3 Burning Cans;
9-12 ● II.C.2 Waste Management Choices.

INFORMATION
II.B.1 Incineration;
C.2 Solid Waste Plan Summary.

RESOURCES
A.5 Incinerators;
B.4 Industry Associations;
B.5 Environmental Groups
C.7 Incineration.

BACKGROUND
About 150 pounds of trash are generated each week by the average American family of four. More space is needed for waste disposal as landfills fill up. Incineration is one answer to the lack of space. Incineration reduces the volume of waste requiring disposal by 80-90%. In a waste-to-energy plant, burning waste can also generate electricity for community needs. However, toxic substances such as dioxin may be released into the air, creating air pollution and possible health hazards. Dust and noise pollution are other possible problems associated with incineration. Incineration is most efficient when certain materials are separated out of the waste stream. Newspapers may raise the burning temperature too high for efficient burning, and they pollute the ash with heavy metals. Metals and glass do not burn. Because newspaper, steel, aluminum and glass are all recyclable, separation of these materials from the waste stream prior to incineration contribute to resource conservation and efficient plant operation. However, separating and recycling materials may be costly. The pros and cons of incineration need to be weighed by people looking for solutions for solid waste disposal and pollution. There are no right or wrong answers, only informed opinions.

LEADING QUESTION
Is burning a good way to get rid of trash?

PROCEDURE
1. Discuss in class the pros and cons of incineration. Invite guest speakers who can present both points of view.

2. Visit a waste incineration plant.

3. Construct a wall chart comparing the advantages and disadvantages of waste incineration.

EVALUATION
Have students list the pros and cons of waste incineration.

EXTENSIONS
A. Take a sampling of trash. Sort it for items that could be reused or recycled, removing them from the waste stream. Compare the amount left to be burned to the original sampling. Discuss the implications of burning our natural resources versus recycling them.

B. "Wastus Solidus" activity.

Vocabulary: incineration, dioxin, ash, heavy metal.

Name: **Date:**

THE LIFECYCLE OF THE SPECIES WASTUS SOLIDUS

Have students draw the lifecycle of the imaginary creature Wastus Solidus that is incinerated. Start with its birth in a garbage can or dumpster, and follow it through incineration. After incineration, the Wastus Solidus divides and follows several different paths--captured electrical energy used in our community, ash buried in a landfill, and air emissions from smoke stacks. Make sure students include these in their drawing. As an extension, have students draw the lifecycle of- Wastus Solidus that is buried in a landfill or that is recycled. Make sure to note that the lifecycle of Wastus Solidus does not end with death, since the waste we make stays as part of our environment forever.

SOLID WASTE BULLETIN BOARD

4-6 ● II.C.

Concept
What we choose to do with our trash (reuse, recycle, recover or revise) will have an impact on our lives and our environment.

Objective
Students will evaluate solid waste items and decide which of the above four categories to place them in.

Method
Students will bring solid waste items from home or find them in the classroom and categorize them.

Materials
Bulletin board, thumbtacks, solid waste items from home.

Subjects
Science, Social Studies.

Skills
Evaluating, decision making, classifying, experimenting.

Time
Can be run throughout unit on recycling.

Source
Kathy Jacob, Clarendon Elementary School, Clarendon.

Resources
The Trash Monster.

AVR Guide Resources
PARALLEL ACTIVITIES
9-12 ● II.C.2 Waste Management Choices.

INFORMATION
I.C Public Planning and Policy.

BACKGROUND
Solid waste can be classified as re-usable, recyclable, recoverable, or as a product that needs to be revised. 1) Revise means to change (habits and attitudes in buying and using products as well as redesigning products). 2) Reuse means to use again. 3) Recycle means to collect used products and make them into new products. 4) Recover means to produce energy by burning trash.

LEADING QUESTION
What can I do with this piece of solid waste?

PROCEDURE

1. Introduce the concepts of Revise, Reuse, Recycle, and Recover.

2. Set up a bulletin board divided into sections with those four categories as headings. Have students begin tacking up items appropriate to each heading and have them explain why it belongs in that category. Some items may be appropriate to more than one heading.

EVALUATION
Can the student reasonably explain their choice of category for the item they are displaying?

EXTENSIONS

A. For the items in the "Revise" category, how could it be changed? Have the students re-design the product to be less wasteful.

B. Do "Solidus Wastus" activity under 4-6 ● II.B.2 Investigating Incineration.

Vocabulary: revise, reuse, recycle, recover.

SOLID WASTE BULLETIN BOARD 4-6 ● II.C.1

Name: **Date:**

I can't	I don't want to	I might	I'll do it sometimes	Easy, I'll do it	
					walk instead of asking for a ride
					ride a bike instead of asking for a ride
					throw papers in trash cans
					use dishes instead of paper plates and paper cups
					save newspapers for recycling
					use the back of writing and drawing paper
					save envelopes and wrapping paper to use again
					save cans and bottles for recycling
					use plastic bags over and over
					avoid buying things in plastic containers or wrappers
					turn off all water faucets tightly
					fix drips and leaks
					don't let water keep running when you brush your teeth
					run dishwashers and washing machines only with full loads
					don't use the toilet as a wastebasket
					turn off lights when you're not using them
					plant trees
					fix things instead of throwing them out
					give outgrown clothes to someone smaller
					share books and games with your friends
					talk to people about ecology
					add things to this list and make copies for other people

PONDERING PACKAGING 4-6 ● III.A.1

Concept
Overpackaging contributes to waste and is often unnecessary.

Objective
Students will examine examples of over or conglomerate packaging, will assess its negative impact and will brainstorm alternatives.

Method
Students will compare different packaging.

Materials
Five different examples of wasteful packaging *(i.e.: brickpacks, disposable razor in plastic bag, individually-wrapped hardware items, individually wrapped cheese slices, fruits and vegetables individually wrapped in styrofoam and plastic film, etc.)*

Subjects
Social Studies, Science.

Skills
Brainstorming, describing and comparing, problem solving.

Time
One class period.

Source
Workshop.

Resources
Environmental Action Coalition, ECO-NEWS Vol.3, No.5 (January 1973.

AVR Guide Resources
PARALLEL ACTIVITIES
K-3 ● III.A.1 Egg Cartons;
7-8 ● III.A.1 Packaging Design.
INFORMATION
I.A.5 Components of the Waste Stream; I.A.7 Packaging;
III.A Redesign and Reuse.
RESOURCES
B.4 Industry Associations;
C.8 Plastics and Packaging.

BACKGROUND
It is estimated that 33-40% of solid waste in the United States is packaging--more than 44 million tons each year. Packaging is designed to protect its contents from physical damage and spoilage, and thus allows transportation of goods from far away, without adding broken or rotten objects to the waste stream. For example, in the U.S. it is estimated that only 12% of transported food spoils, while in the U.S.S.R. some 50% of transported food spoils. Packaging not directly related to these two functions is what is often considered excessive packaging. Packaging is made from a variety of materials, some recyclable or compostable and others not. Increasingly metal, glass, and paper/cardboard materials, all recyclable or compostable, are being replaced by plastic or multi-type, multi-layered materials which are almost impossible to recycle or compost.

LEADING QUESTION
What problems does packaging pose?

PROCEDURE

1. Brainstorm types of packaging with class. Have students bring in samples

2. Break the class into five groups and give one example to each group. Have each group unwrap each package and record the different kinds of packaging material. Why was a particular type of packaging used? Was it necessary? Was it recyclable or reusable?

3. Have each group design an alternative packaging for their example. See 7-8 ● III.A.1 PACKAGING DESIGN.

4. Using the subjects of discussion, make a display to show excess or bad packaging and possible alternatives.

EVALUATION
Students should be able to identify several examples of overpackaging, accompanying problems, and reasonable alternatives.

EXTENSIONS

A. Identify examples of well-designed packaging (from an environmental perspective).

B. Debate the use of one kind of packaging compared to another.

C. Invite a packaging industry representative and an environmentalist to class to discuss opposing views of packaging.

D. Reuse packaging materials in a collage or sculpture.

E. Make a bulliten board display comparing natural and human-made packaging.

Vocabulary: packaging, over-packaging, reusable, recyclable, conglomerate packaging.

THE GARBAGE-RICH HOME

Household garbage comes in two main types – the leftovers from day-to-day living, such as packaging, bottles, cans, and newspapers, and then once-in-a-while waste such as broken appliances, old furniture, worn-out carpets, and so on. The latter is an inescapable result of modern life, but the former, which makes up the bulk of household garbage, can be greatly reduced without too much difficulty.

POSITIVE ACTION

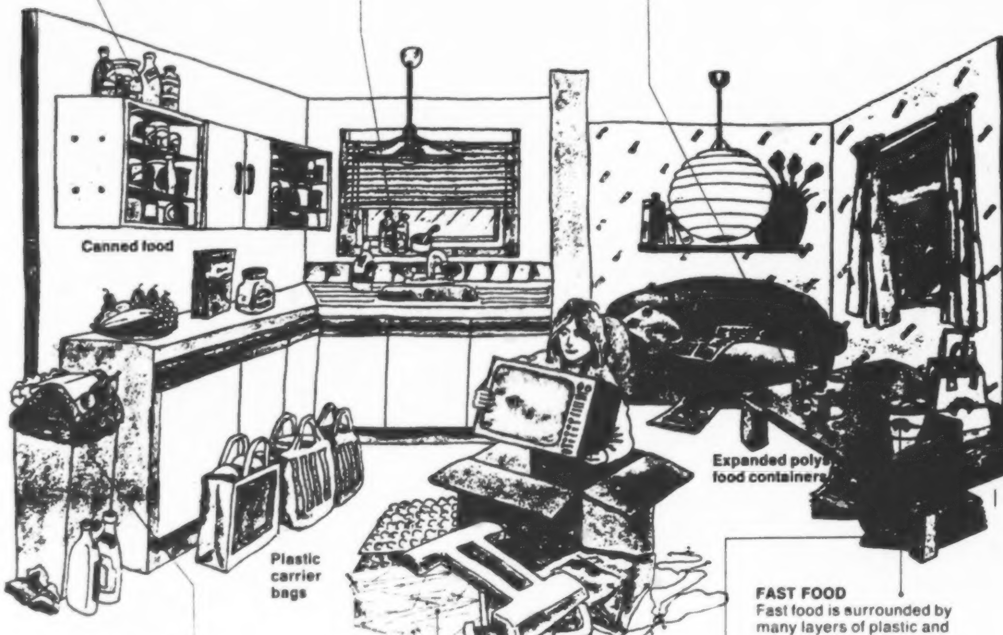
Six steps for reducing your household garbage

- **Don't mix up your garbage**
  Ideally, every house should have a separate can for glass, paper, metal, and organic matter so that each can be recycled. Recycling kitchen waste is not possible if you don't have a garden, but recycling paper and glass certainly should be.
- **Apply the overpackaging test**
  Excessive packaging is the most avoidable source of household waste. Choose products that are contained in the least amount of packaging, and never buy those that fail the overpackaging test (see p. 84).
- **Buy in bulk**
  Regular household products packaged in small quantities produce more waste than those packaged in large quantities. Six separate cans of drink, for example, will produce far more waste than a single bottle containing the same amount. So whenever possible, buy the biggest size.
- **Choose returnable containers**
  Returnable bottles are vastly better than cans, although over recent years they have greatly declined in number. Choose them and other returnable containers whenever possible.
- **Choose natural packaging**
  Packaging made of paper or cardboard is preferable to plastic because it can be recycled. For the same reason, glass bottles are much better than plastic ones – especially if they are returnable.

GLASS BOTTLES AND JARS
The raw materials for making glass are abundant, but it takes about 38 gallons of oil to heat them sufficiently to produce 1 ton of finished glass. Throwing away bottles is therefore a considerable waste of energy.

PLASTIC PACKAGING
Plastic makes up about one-tenth of household garbage; most of it is used as packaging. Plastics cause immense problems in waste incineration because many of them give off poisonous gases when burned.

ALUMINUM CANS
Aluminum is a relatively new but rapidly increasing constituent of household waste. Four-fifths of aluminum could be recycled, but at present nearly that amount is simply thrown away.



UNSORTED WASTE
Putting all household waste into one can makes recycling almost impossible. The mix of organic matter and household chemicals in the unsorted waste also presents disposal hazards.

COMPOSITE MATERIALS
Many household products are packed in composite materials – mixtures of plastics, paper, and metal that cannot be separated, and so cannot be recycled.

NEWSPAPERS AND MAGAZINES
Throwing a year's newspapers into the garbage can wastes at least 220 pounds of paper – a valuable commodity which could easily be recycled.

FAST FOOD
Fast food is surrounded by many layers of plastic and paper. Large quantities of materials go into making packaging which is then used for a ridiculously short time.

From *Blueprint for a Green Planet* by John Seymour and Herbert Girardet (c) 1987. Reprinted by permission of the publisher, Prentice Hall Press, New York, NY

WISE USE OF PAPER 4-6 ● III.A.2

Concept
Many of our daily habits are wasteful regarding the use of paper.

Objective
Students will learn how much paper is wasted and will learn ways to conserve it.

Method
Students will collect and measure the amount of waste paper they consume in the classroom in a week.

Materials
Waste paper, two boxes, scale, paper for a graph.

Subjects
Math, Social Studies.

Skills
Measuring, categorizing, graphing, expirmenting.

Time
Two weeks.

Source
A Way With Waste.

Resources
American Paper Institute; Vermont Department of Forests, Parks and Recreation; *Project Learning Tree*; Earth Care Paper Company; Vicki Cobb, *The Secret Life of School Supplies*; Environmental Action Coalition, *It's Your Environment: Things To Think About, Things To Do.*

AVR Guide Resources
PARALLEL ACTIVITIES
K-3 ● III.A.2 Yesterday's Paper;
K-3 ● III.A.3 Trash or Treasure.
INFORMATION
III.A Redesign and Reuse;
III.B Recycling.
RESOURCES
C.1.c Reuse Activities.

BACKGROUND
The largest single component of solid waste is paper (about 30% by weight and 50% by volume). Americans consume more paper per person than any other people in the world. Each person in the United States uses approximately 600 pounds of paper annually (the equivalent of two harvestable trees). Individuals are the first links in the paper recycling process. By reusing and recycling paper we can help conserve resources, protect the environment and reduce energy use. Each ton of paper that is recycled replaces and preserves 13-20 500-pound, harvestable trees. Making paper from recycled fibers uses 30 to 55% less energy than making paper directly from trees and reduces the air pollution from the manufacturing process by 95%.

LEADING QUESTION
How much paper do you think you use? Do you need to use all of it?

PROCEDURE
1. For one week, have the students collect the classroom paper they would normally throw away. Weigh the paper each day. Construct a graph showing daily weights. Divide the collected discarded paper into two boxes: paper we can still use, paper we have used completely. At the end of the week compare the two results. Could we have used less paper? How can we reduce the amount of paper we use?

2. Repeat step 1 for a second week and compare to the first week. Have attitudes and habits changed? Repeat again in a month or do once a month and graph.

EVALUATION
Have habits and attitudes changed?

EXTENSIONS

A. Working with a partner, make two lists: first, list all the paper products you use at home: and second, list substitute products to use in place of paper products.

PAPER ITEMS	*OTHER CHOICES*
paper napkins	cloth napkins
paper dishes	washable glasses
kleenex	handkerchief
paper towels	dishcloths

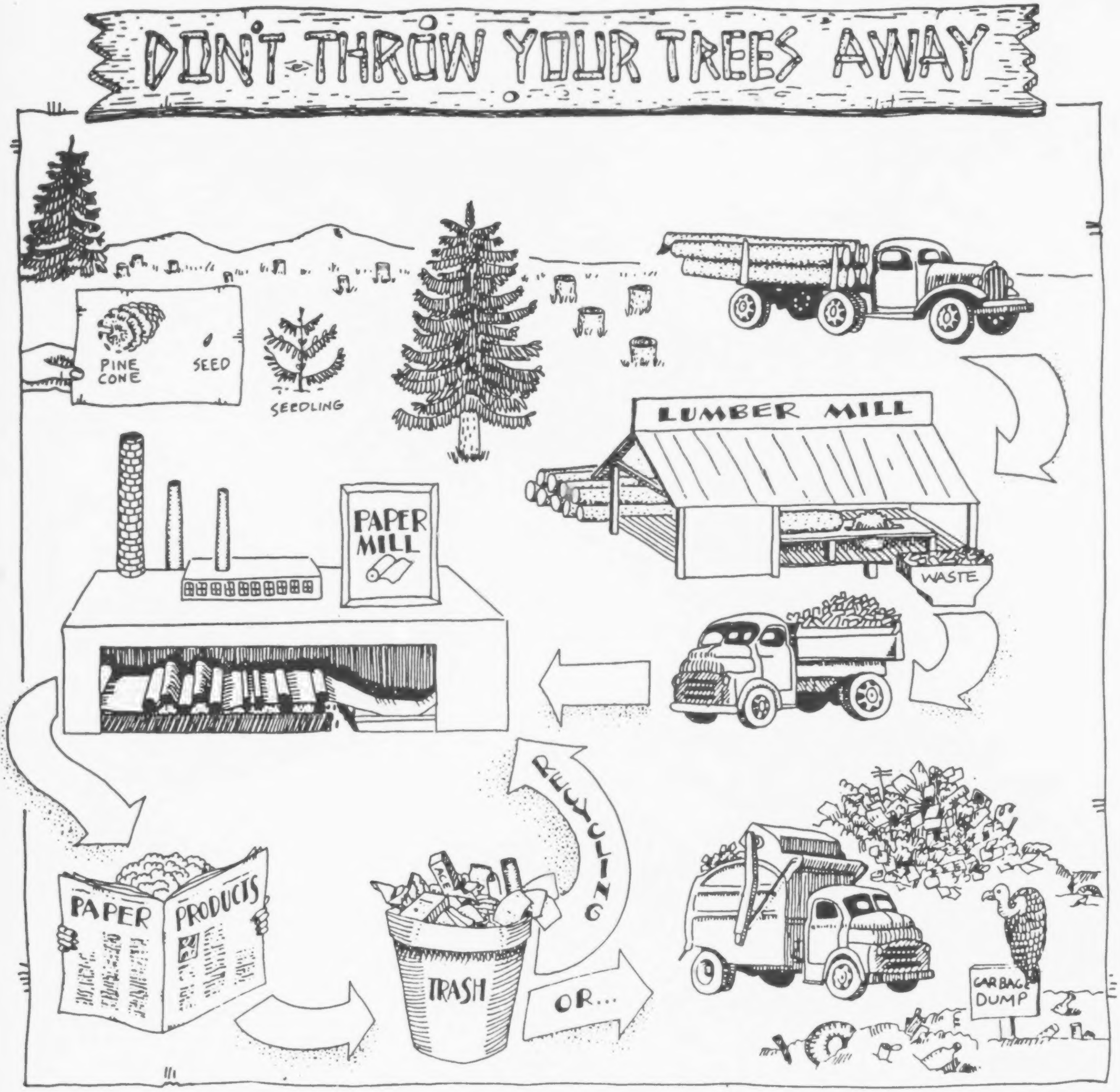
B. Visit a paper mill or paper recycling industry.

C. Make recycled paper. See Activity 4-6 ● III.B.2 PAPERMAKING.

D. Use your results to predict the amount of paper the school uses in a year. a. Research marketing possibilities for the school's waste paper. Contact local recyclers. b. Compare school results to a local business's use of paper. Perhaps children could visit a business to weigh waste paper.

Vocabulary: recycle, reuse.

Name: **Date:**



National Center for Appropriate Technology, Sophie Diven, illustrator

HOW CAN REUSE THINGS TO WASTE LESS?

NEW THINGS FROM OLD

4-6 ● III.A.3

Concepts
Reusing waste will conserve natural resources and save landfill space.

Objective
Students will learn that they can reuse material to make useful objects.

Method
Students will look at examples of old quilts and will make their own object from scrap fabric.

Materials
Fabric scraps, scissors, thread and needles.

Subjects
Art, Social Studies, Language Arts.

Skills
Sewing, designing, conserving.

Sources
A Way With Waste; Workshop.

Resources
Shelburne Museum; Billings Farm and Museum; local historical societies; books by Eric Sloane; quilt books; Vt. Council on the Arts; Sewing and reuse books for kids; Carolyn Jabs, *RE/USES.*

AVR Guide Resources

PARALLEL ACTIVITIES

K-3 ● III.A.2 Yesterday's Paper;
K-3 ● III.A.3 Trash or Treasure?;
7-8 ● I.C.2 Art Reflecting the Environment.

INFORMATION

I.C Waste and Society;
III.A Redesign and Reuse.

RESOURCES

C.1.c Reuse Activities.

BACKGROUND

Use it up, wear it out, make it do, or do without.

One hundred years ago, Vermonters threw out very little. They made use of everything they could because purchasing new materials was expensive and difficult. Following the old "waste not, want not" ethic saved money and made solid waste problems almost non-existent. Great Grandmother braided rugs, made patchwork quilts, and found many other uses for the scraps of material that she carefully saved from worn-out clothes. Quilt-making has become a popular craft again, in most cases not as a way to conserve resources, but for the decorative and artistic value in the quilts. Many people today buy new fabric for their quilts or rugs and throw out the excess.

LEADING QUESTION
Why did our grandparents make patchwork quilts?

PROCEDURE
1. Bring in a real patchwork quilt to touch and see, if possible. Discuss what patchwork quilts are made of. Why? Why didn't people just go to the store and buy a new blanket or comforter?

2. Ask students to collect scraps of fabric (nothing new!). Have them ask family members for materials and if they have ever made a patchwork quilt or similar item before. Did they use new fabric or old?

3. Make a theme quilt as a class, or have students make their own small useful objects such as bookbags, pillow covers, satchels, potholders, sports bags, bike bags, computer keyboard covers, etc. This project may be done at school or at home. Students will present their product to the class and explain where the materials came from. (For a shorter lesson, have material scraps available in a bag for the class. Then, rather than sewing a quilt, have students lay scraps together in a pattern for a "pretend" quilt or other useful object.)

EVALUATION
Why is it important to reuse things instead of tossing them out?

EXTENSIONS
A. Invite a quilt, rug, paper maker or other artisan to visit and demonstrate his or her craft. The Vermont Council on the Arts publishes a list of Vermont artists and craftpeople.
B. Visit a museum to explore other reuses in history.
C. Have students list some items that we produce today which Great Grandmother did not have. Are they improvements? Bring an older person into the class to talk about how things used to be, and discuss what modern developments they think have been improvements.
D. Visit a nursing home and interview the residents about how life used to be and how products have changed.
E. Have students make a "patchwork" poster from discarded packaging materials.

Vocabulary: reusing, textiles, conserving, resources, patchwork quilt.

NEW THINGS FROM OLD 4-6 ● III.A.3

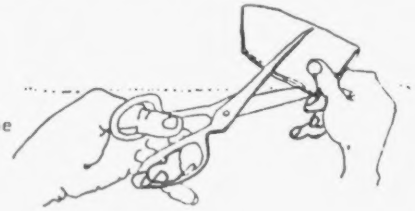
Name: **Date:**

-materials-

- used yellow *styrofoam* chicken trays for printing block. (only yellow *styrofoam* will hold the paint onto its surface.)
- use a flat surfaced tray for the paint rolling surface.
- newspaper
- poster paint
- *scrap* construction paper

-tools-

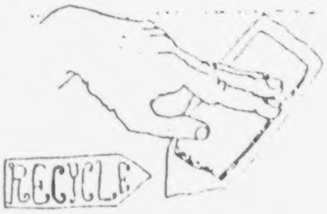
- scissors
- pencil for carving
- used *plastic* spoon
- brayer (roller), or sponge.



1) Spread out newspaper to work on.
2) Cut the bookmarker printing block out of your yellow tray. Make it any shape you like.

3) With a pencil, write the work RECYCLE backwards (Ǝ⅃ƆYƆƎЯ) in the *styrofoam* Press the pencil point 1/8 inch in when carving. Practice on a piece of paper. Hold the piece of paper up to a mirror and look at the image. What happens? Try different ways to make the word look exciting or fancy.
4) Place a spoonful of poster paint in a tray, rolling it out with a brayer or sponge in a solid even layer.

5) Roll a solid even layer of paint onto your brayer or dab a sponge onto the paint. Roll or dab this over your carved piece of *styrofoam*. Keep the paint out of the wording you've carved.



6) Place the printed surface of your printing block onto a piece of *scrap* construction paper. Press the entire area of the block with your fingers to make sure the paint transfers. The paint will print better if there is layer of newspaper underneath.
7) Wash your paint rolling trays and keep for another time.
8) Cut out your bookmarkers and use, share with friends, or leave a stack of them at a library for the public to use.

9) How much waste did you create by using *styrofoam*? How much did you throw away?

Adapted from *Garbage Reincarnation* from Sonoma Conservation and Recycling, PO Box 1375, Santa Rosa, CA 95402

WHERE FROM, WHERE TO?

4-6 ● III.B.1

Concept
Everything we make, use and throw away comes from and returns to the earth.

Objective
Students will trace objects from their source, to the consumer, and back again.

Method
Students will examine and trace the life cycles of common household objects.

Materials
One object made of one material per student.

Subjects
Language Arts, Social Studies, Science.

Skills
Sequencing, experimenting analyzing.

Time
One class period.

Sources
Project Learning Tree; *Recyculum*; Workshop.

Resources
Toast, (film available from the Energy Center in Vernon); Vicki Cobb, *The Secret Life of School Supplies*.

AVR Guide Resources

PARALLEL ACTIVITIES

K-3 ● III.B.1 Cycles;

7-8 ● III.B.3 Destination Recycle.

INFORMATION

I.A.5 Components of the Waste Stream;

III.B. Recycling.

RESOURCES

C.5 Recycling.

LEADING QUESTION
Where do things we use come from and where do they go to?

PROCEDURE

1. Ask each student to bring to class a common household object made from only one material (e.g. rubber eraser, glass jar, piece of paper, plastic bag). Each student will identify the natural resources used and the steps taken to make the object and deliver it to the consumer. Then trace all the steps needed to recycle the product back into another object. Illustrate the life cycle.

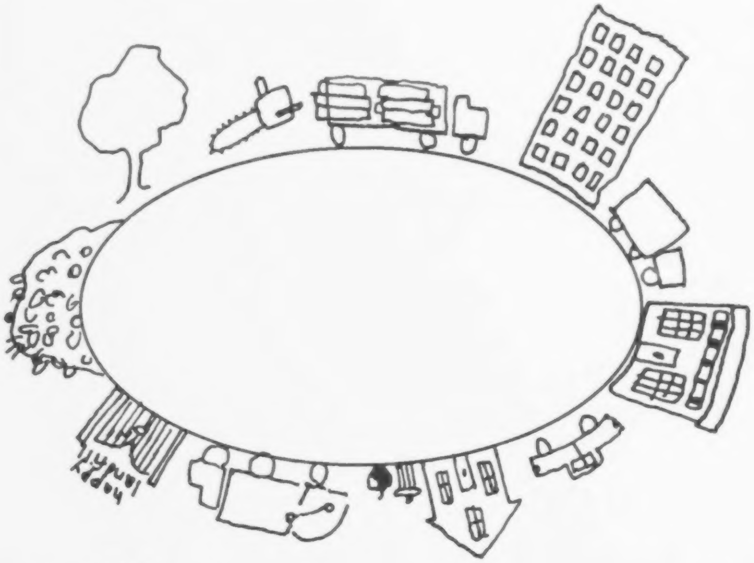
2. Discuss the different steps required to produce the things we use each day. How many times is the object transported in its life time? By what? Using what as fuel? Is the object easily reusable? Is it easily recyclable? What are the environmental effects of producing and transporting the object?

EVALUATION
Students should be able to trace the life cycle of any object made from one material. How many steps or phases are there in the lifecycle of your object?

EXTENSIONS

A. Trace the life cycle of a pencil or other commonly used, inexpensive object made from several different resources. Is a pencil easily recyclable?

B. Roleplay the life cycles of different objects (e.g. one recycled vs. one landfilled; styrofoam vs. paper, etc.).

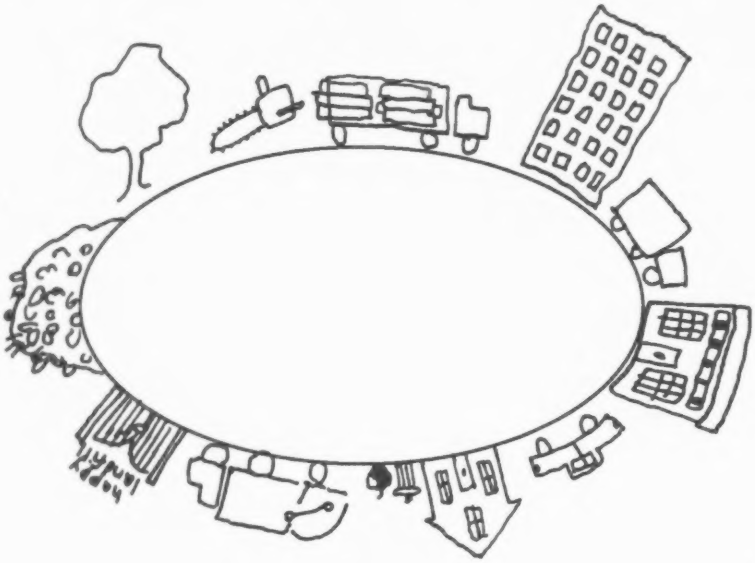


Vocabulary: cycle, resource, reuse, recycle, transportation, energy.

WHERE FROM, WHERE TO? 4-6 ● III.B.1

Name: **Date:**

tree
logger cuts
trucker hauls
processed in mill
furniture factory buys wood
trucker hauls
factory processes into candlesticks
trucker hauls
wholesale store buys
trucker hauls
retail store buys
transports
customer buys and uses
transports
thrift store
transports
discarded in landfill
decays into contaminated soil



Lifecycle Of:

PAPERMAKING 4-6 ● III.B.2

Concept
Our natural resources can be reused and recycled into new and useful products.

Objective
Students will learn how paper is recycled.

Method
Students will make their own recycled paper.

Materials
Scrap paper (preferably white ledger paper, construction paper for coloring), decorative filler scraps (flowers, seeds, pine needles, small pieces colorful paper, yarn, thread, feathers, etc.), two wooden frames the same size, nylon fly screening or substitute, many absorbent rags at least as large as the frames, one wash basin, blender, sponge.

Subjects
Art, Science.

Skills
Designing, experimenting, observing, predicting.

Time
Two hours.

Source
Ontario Science Centre.

Resources
American Paper Institute; Vermont Department of Parks and Recreation; Vicki Cobb, *The Secret Life of School Supplies*; Leonard Fisher, *The Paper Makers*; Gail Gibbons, *Paper, Paper Everywhere*; Arnold E. Grummer, *Paper By Kids*.

AVR Guide Resources

PARALLEL ACTIVITIES

9-12 ● III.B.1 Recycling Paper Pollution.

INFORMATION

I.A.5.a Paper;
III.B. Recycling.

RESOURCES

C.5 Recycling.

BACKGROUND
The trickiest part of making paper is finding enough absorbent material to sop up all the water. Make sure to have plenty of sponges, sheets and towels handy. (You might want to have each child bring in his or her own toweling.) Avoid using newspaper if possible. Newsprint will turn everything dark grey, and if you dry on a sheet of newspaper, you will not be able to recycle it! If you would like everyone in the class to get a chance in one class period, you might want to set up stations around the class, so that there is one basin with mould and deckle for each four to five students.

LEADING QUESTION
Why should we recycle paper?

PROCEDURE

1. Explain the process of making paper.

2. Follow the attached directions to make a sheet of paper. Emphasize the reasons for recycling: resource conservation, less energy used, less waste needing landfilling. Also discuss the related problems of water pollution, contaminants, paper grades, costs of collection and transport, etc.

EVALUATION
What are the steps required to turn waste paper into new paper? What are some of the problems in recycling paper?

EXTENSIONS
A. Children can write poems (e.g. Haiku) or try calligraphy on their aper (if you use pens or pencils that do not bleed).

B. Contact the State of Vermont Recycling Hotline (1-800-932-7100) and learn what types of paper are commercially recycled, how to prepare the paper for recycling, and where the closest paper recycler is.

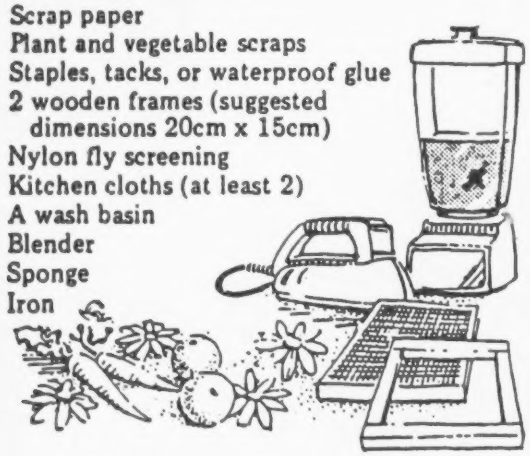
C. Weigh all the waste paper your class generates in a week. Separate the recyclable portion, and weigh the remainder to see how much the class can save for recycling. Have a contest with another class to see who can save the most.

Vocabulary: papermaking, mould, deckle, pulp, screen.

PAPERMAKING AT HOME

Equipment

Scrap paper
Plant and vegetable scraps
Staples, tacks, or waterproof glue
2 wooden frames (suggested dimensions 20cm x 15cm)
Nylon fly screening
Kitchen cloths (at least 2)
A wash basin
Blender
Sponge
Iron



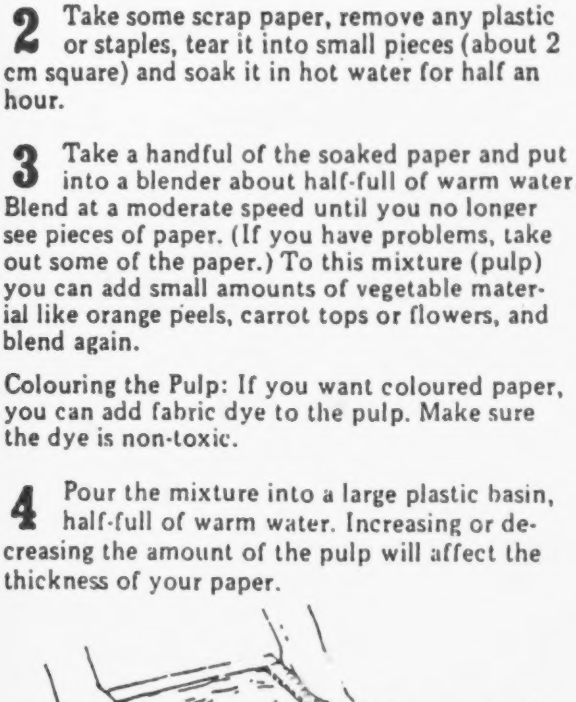
1 To make paper you must first make a 'paper mould' - a wooden frame with nylon fly screen stapled tightly to it. You can use a second wooden frame (deckle) without the fly screen to help make your paper more even.

2 Take some scrap paper, remove any plastic or staples, tear it into small pieces (about 2 cm square) and soak it in hot water for half an hour.

3 Take a handful of the soaked paper and put into a blender about half-full of warm water. Blend at a moderate speed until you no longer see pieces of paper. (If you have problems, take out some of the paper.) To this mixture (pulp) you can add small amounts of vegetable material like orange peels, carrot tops or flowers, and blend again.

Colouring the Pulp: If you want coloured paper, you can add fabric dye to the pulp. Make sure the dye is non-toxic.

4 Pour the mixture into a large plastic basin, half-full of warm water. Increasing or decreasing the amount of the pulp will affect the thickness of your paper.



5 Place the deckle on top of your screen. With both hands, dip the mould into the basin and scoop up some of the pulp. Gently shake the mould back and forth to get an even layer of fibres on the screen. When the water has drained through, place the mould to one side and carefully lift off the deckle, leaving the just-formed sheet on the screen.

6 To remove the paper from the screen, lay a clean kitchen cloth on a flat table, then take the screen and lay it face down on the cloth. Soak up any extra water from the back of the screen with a sponge. Very gently lift the screen the paper should remain on the cloth.

7 To dry the paper quickly, cover it with another cloth and iron at a medium dry setting. Once dry, pull gently on either side of the cloth to stretch it - this helps loosen the paper from the cloth. Gently peel the paper off.

8 A CLEAN UP NOTE: When you've finished, collect the left over pulp in a strainer. Be careful NOT to pour pulp down the drain - it might block it. The strained pulp can be thrown out or kept in a plastic bag in the freezer for the next time.

Bibliography

Heller, Jules. *Papermaking.* New York: Watson-Guptill, 1978.

Hunter, Dard. *Papermaking: the History and Technique of an Ancient Craft.* 2nd ed. New York: A. Knopf, 1947. Reprinted: New York, Dover Publications, 1978.

Studley, Vance. *The Art and Craft of Handmade Paper.* New York: Van Nostrand Reinhold, 1977.

If you have any suggestions or require more information, write to:

The Printed Word,
Printing and Papermaking,
Ontario Science Centre,
770 Don Mills Road,
Don Mills, Ontario.
M3C 1T3

ONTARIO SCIENCE CENTRE

WHERE TO RECYCLE

4-6 ● III.B.3

Concepts
Recyclables should be source separated; publicity for recycling centers is necessary for their success.

Objective
Students will gather information about where materials can be recycled.

Method
Teachers will invite guest speakers to present information on recycling centers.

Materials
Maps, list of places to recycle (resource section A.7), mapmaking materials.

Subjects
Science, Social Studies, Language Arts.

Skills
Listening, mapmaking, researching.

Time
Several class periods.

Resources
ANR; AVR; town clerks; solid waste management districts and planning commissions.

AVR Guide Resources

PARALLEL ACTIVITIES

K-3 ● III.B.2 What's Recyclable;
7-8 ● III.B.3 Destination Recycle;
9-12 ● III.B.2 Collecting and Sorting.

INFORMATION

III.B Recycling.

RESOURCES

A.1 State of Vermont;
A.2 Planning Commissions;
A.3 Solid Waste Districts;
A.7 Places to Recycle;
A.8 Recycling Groups;
A.9 Recycling Businesses;
C.5 Recycling.

BACKGROUND

Successful recycling depends in part on public education, publicity and convenience. Most people agree that recycling benefits the environment and helps reduce disposal problems. They would like to recycle, but don't because they either do not know how to recycle, where to recycle, or available recycling centers are too far away or collection days too infrequent. Therefore, public education and convenience are vital parts of any successful recycling program.

LEADING QUESTION

What is recyclable and where can we take our recyclables?

PROCEDURE

1. List recyclables on the board. Include the following: three colors glass, plastic beverage bottles (PET), plastic detergent and milk jugs (HDPE), newspaper, ledger paper, mixed paper, mixed plastic, corrugated cardboard, aluminum (cans, pie plates, foil), steel cans, other metals, batteries, oil, etc. Discuss methods of preparation for various materials. Review what happens to the items when they are recycled. Do you and the students know where these items can be recycled locally? If not locally, where in the state? Call the State of Vermont Recycling Hotline (1-800-932-7100) to findout.

2. Have the town recycling committee or a regional Solid Waste Commission member visit your classroom to talk about local recycling efforts.

EVALUATION

Students should know where to recycle various materials and will begin to understand the complexities of setting up and maintaining successful recycling programs.

EXTENSION

A. Make maps of recycling centers in your area. Display maps at home or contribute maps to local bulletin boards, businesses, etc. to stimulate recycling activity in the community.

B. Make a map of the towns in your Solid Waste District, showing collection points for solid waste and recyclables.

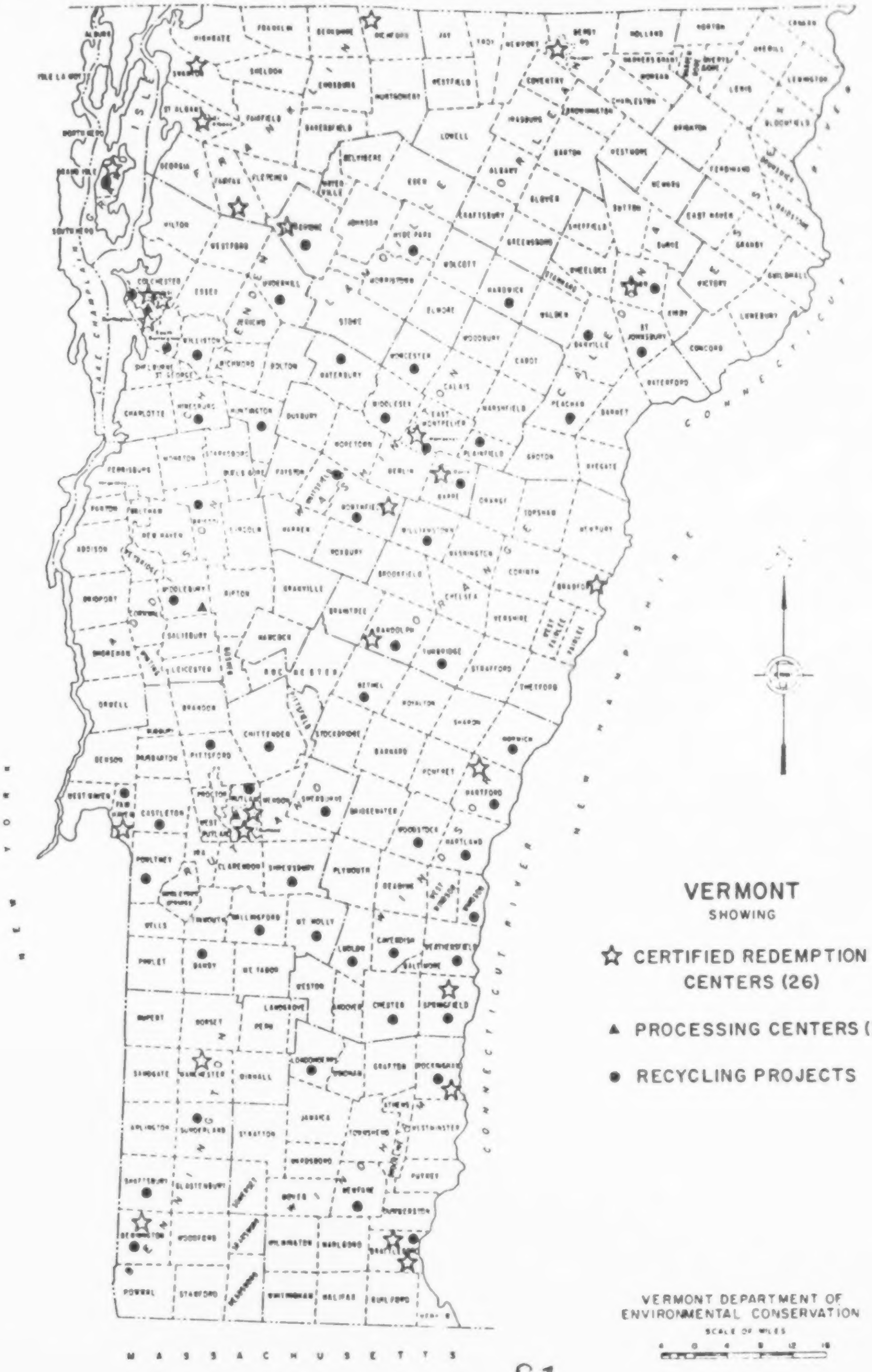
C. Create an informational flyer for giving away at area businesses (banks, supermakets).

D. Write letters to the editor of your local newspaper(s) about what students have learned.

Vocabulary: Solid Waste District, collection points, recycling center, source separation.

A MAP OF STATE RECYCLING OPPORTUNITIES

(As of 12/88. Call the Agency of Natural Resources at (802) 244-7831 for updated versions.)



MINI-COMPOST

4-6 ● III.C.1

Concept
Organic waste can be recycled to enrich soil for growing more organic matter.

Objective
Students will learn about recycling organic matter.

Method
Students will build a model compost pile in a classroom terrarium.

Materials
Aquarium, organic wastes, soil (not potting soil), thermometer, trowel or large spoon, 1-2 dozen red earthworms.

Subject
Science.

Skills
Sorting and classifying, inferring, predicting, observing.

Time
One class period to a full year.

Sources
Workshop; *Recycling Study Guide.*

Resources
"The Wild World of Compost", *National Geographic*; Mary Appelhof, *Worms Eat My Garbage ; Pat Hughey, Scavengers and Decomposers.*

AVR Guide Resources
PARALLEL ACTIVITIES
K-3 ● III.C.1 Banana Peel Blues;
7-8 ● III.C.1 Making Good Compost;
9-12 ● III.C.1 Microorganisms;
9-12 ● III.C.2 Effective Fertilizers.
INFORMATION
III.C Composting.
RESOURCES
C.6 Composting.

BACKGROUND
When we mention 'recycling,' we often think of recycling glass bottles, aluminum cans and newspapers. But another 30% of the household garbage we throw out also can be recycled. These recyclables are food scraps, leaves, grass clippings and other biodegradable organic wastes. Organic wastes can be recycled by composting. Simply stated, composting creates optimal conditions for decomposition to occur. Decomposition is the biochemical process by which bacteria, fungi and other microscopic organisms break organic "wastes" into nutrients that can be used by plants and animals. Decomposition occurs in nature whenever a leaf falls to the ground or an animal dies. It is essential for the continuation of life on earth. The result of decomposition in a compost pile is a nutrient-rich humus that is excellent for improving soil quality and plant growth. --Recycling Study Guide.

LEADING QUESTION
What do you do with your food scraps?

PROCEDURE
1. Assemble a variety of organic wastes including with following: manure and green grass clippings, sawdust, hair, wood ash, leaves, kitchen food scraps, etc. Avoid meat scraps, dairy products, fats and oils which inhibit decomposition, cause odors, and can attract pests. Chop the organic wastes into small pieces. You can leave some large pieces of the same materials to compare rates of decomposition between large and small items. Why might there be a difference?
2. Alternate layers of the materials as follows (amounts are approximate): inch of soil, two inches of organic waste, sprinkle of manure or green grass clippings, sprinkle of water, repeat.
3. Cover with an inch of soil. Water the pile enough to make it moist but not soggy. It should feel like a damp sponge (it feels moist, but you can't squeeze water out of it).
4. Add the earthworms and observe their behavior.
5. Place your compost pile where it will be at room temperature (not in direct sun). Gently mix the compost once a week to aerate it. Use a themometer to test the temperature of the pile. (For consistency do it at the same location and depth at the same time each day.) Make a graph of results.
6. Discuss composting. How does it reduce the amount of waste you would have thrown out? What do you think happens to organic wastes that end up in the landfill? Is the landfill a gigantic natural compost pile, or are there problems with placing large amounts of organic material in landfills?

EVALUATION
Students will identify the ingredients of a compost pile.

EXTENSIONS
A. Construct a compost pile at home to use for the family garden.

B. Begin a school garden. Use the soil you've made to plant some flowers or vegetables.

Vocabulary: compost, organic, decompose.

Necessary Components Of A Compost Pile

SOIL: contains microorganisms that help decomposition.

ORGANIC WASTES: such as leaves, food scraps and grass clippings. Wastes should be varied, including materials with both carbon and nitrogen. By alternating layers of high-carbon and high-nitrogen materials, you can create good environmental conditions for decomposition to occur.

NITROGEN: many of the organisms responsible for decomposition need nitrogen, thus nitrogen is necessary for rapid and thorough decomposition. Nitrogen is found naturally in many organic wastes, such as manure and green grass clippings, as well as in many commercial fertilizers.

WORMS: they eat the waste, helping to break it down; make droppings, which enrich the soil; tunnel through and aerate the waste, facilitating decomposition, and eventually die and become part of the compost.

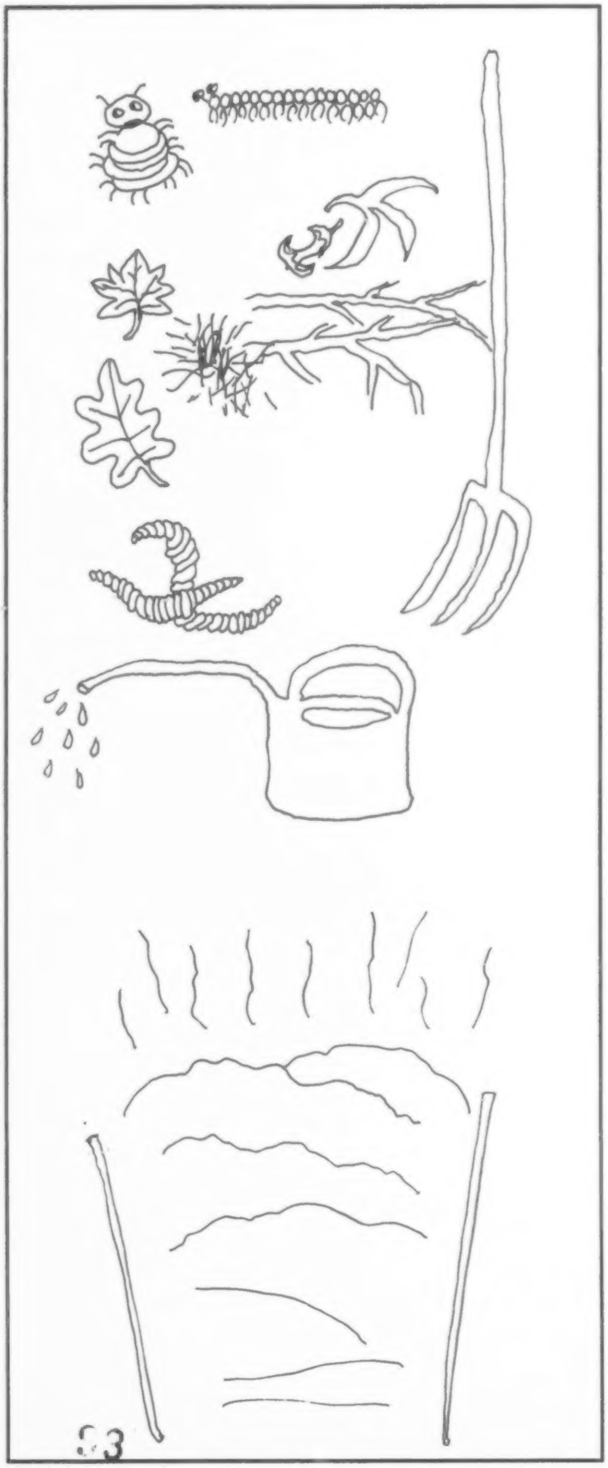
WATER: necessary for normal functioning of life. Too much water in a compost pile may make it soggy and slow decomposition by reducing needed oxygen.

AIR: the biological activity of fungi, bacteria, small insects and other organisms results in decomposition. Most biological processes require adequate amounts of oxygen.

TIME: decomposition takes time. To speed up decomposition, aerate your pile every few days; otherwise, just leave it and wait.

HEAT: heat is produced by chemical reactions resulting from increased biological activity that occurs during decomposition. Heat helps sanitize compost by killing certain organisms e.g. weed seeds, pathogens, harmful insect larvae).

MASS: in order to generate enough heat for optimal decomposition, the pile must contain at least one cubic meter of organic material. Thus, the temperatures generated in an aquarium compost pile may be different from those generated in one that is larger.



7-8 ACTIVITIES

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I. WHAT IS WASTE?

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- **A. CHANGING HABITS AND DESIGNS**
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- **C. COMPOSTING**
  - 1. MAKING GOOD COMPOST

HOW MUCH SOLID WASTE DO WE PRODUCE?

THROWING IT ALL AWAY

7-8 ● I.A.1

Concept
Our present consumer society produces a great amount of waste.

Objective
Students will begin to understand the sources, content and magnitude of the solid waste problem.

Method
Students (and their families) will answer a questionnaire and class will discuss results.

Materials
Attached worksheet.

Subjects
Social Studies, Language Arts, Math.

Skills
Predicting, inferring, problem solving, interpreting data.

Time
One class period.

Source
Oscar's Options.

Resources
Solid Waste Management Plan, Solid Waste Management Rules, (ANR).

AVR Guide Resources
PARALLEL ACTIVITIES
4-6 ● I.A.2 Lunch Bags.

INFORMATION
I.A The Solid Waste Stream.

RESOURCES
C.4 General.

LEADING QUESTION
What do you know about the solid waste we produce?

PROCEDURE
1. As an introduction to the problems of solid waste, distribute questionnaire to students and allow time for completion.

OPTION: The students could complete the survey at home with their families, then bring it back for discussion the next day.

2. Discuss each of the questions in terms of possible solutions that people can offer as citizens, community members, members of government, business, and industry.

EVALUATION
Do students have a better idea of how much waste is generated in our society? Do they have an idea of how much they and their families contribute to waste generation?

EXTENSIONS
A. Conduct a week-long home waste study where students sort and weigh their own family's trash. Have students calculate percentages of types of trash, make future predictions, etc.

B. Create a bulletin board or display using facts from the background and resource sections: make mini-garbage cans from construction paper or have kids make a piece of trash and write a fact on it.

Vocabulary: solid waste, garbage, trash, obsolescence.

HOW MUCH SOLID WASTE DO WE PRODUCE?

1. *The average American family of four creates about 150 pounds of trash each week.* Multiplied by 52 weeks, this equals 7800 pounds each year. (To help envision this amount of waste, picture 9 horses (950 lbs. each), 4 1/2 cows (1800 lbs. each), 5 pilot whales (1500 lbs. each), or a WW II German fighter plane (7700 lbs.) In 1987, Vermont residents, businesses and industries produced an estimated 500,000 tons of solid waste. With a population of 530,000, this means almost one ton per person in the state.

2. *In the past 50 years, the amount of waste discarded per person in the U.S. has doubled.* Increased packaging, increase in number of disposable items, development of industry and production technology, increase in personal wealth and purchasing power, and the switch to "planned obsolescence" as a design strategy are all contributing factors to the increase in personal consumption and disposal.

3. *Each day, Americans throw away 400 million pounds of edible food.* According to archeologist William Rathje of the University of Arizona, this waste consists in large part of spoiled foods never even used. In addition, what surpluses do farmers in the US create that are never used and eventually require disposal? In stark contrast to the food waste produced in the US are the numbers of people who are underfed and undernourished throughout the world. The United Nations estimates that 460 million people do not receive an adequate amount of the right kinds of food. The diet of these people is frequently lacking in: -calories (fewer than 2200 calories per person each day is the norm throughout China, India, and much of Africa. US citizens consume more than 3300 calories per person each day.) -protein (less than 60 grams per day in the above named places compared to more than 90 grams each day in the U.S.) -needed micronutrients (Malnutrition exists not because we don't produce enough food, but rather because of unequal distribution of what is grown. The most affluent third of the world's population eats well over half the food produced.

4. *We send 20,000 cars to the junkyard each day or seven million cars (and 200 million tires) each year.* Placed end to end these cars each year would reach two-thirds of the distance around the earth at the equator.

5. *7.6 million TV's are thrown out each year.* Television sets last on average ten to fifteen years. The number of appliances and audio- visual equipment thrown out within only a few years of purchase reflects a fast turnover in technology, the consumer desire for state of the art equipment and new fashion, a planned obsolescence design strategy by producers, and the fact that it is often less expensive to buy something new than to repair something old.

6. *90% of packaging (boxes, bags, and wrappers) is thrown out right away, even though an increasing percentage of these materials are made of plastic, a substance noted for non-biodegradability and long life.*

7. *Americans use 50 million tons of paper each year.* It takes 17 trees to produce one ton of paper, and 10,000 trees to print one edition of the Sunday New York Times. Newspaper is usually discarded within 24 hours of being purchased, and only one quarter of the paper produced in the United States is recycled.

8. *Vermonters produced about half a million tons of trash in 1987.*

THROWING IT ALL AWAY 7-8 ● I.A.1

HOW MUCH SOLID WASTE DO WE PRODUCE?

1. The average American family of four creates about ______ pounds of trash each week.

_______ 20 _______ 150 _______ 500 _______ 1000

2. In the past 50 years, the amount of waste discarded per person in the U.S. has_________ .

______stayed the same ______decreased
______doubled ______increased 10 times

3. Each day, Americans throw away _____ million pounds of edible food.

_______ 1 _______ 100 _______ 400 _______ 900

4. We send __________ cars to the junkyard each day.

_______ 250 _______ 1000 _______ 10,000 _______ 20,000

5. How many TV's are thrown out each year?

____ 100,000 ____ 5.2 million ____ 1 million ____ 7.6 million

6. What percentage of packaging (boxes, bags, and wrappers) is thrown out right away?

_______ 90% _______ 75% _______ 50% _______ 10%

7. How much paper do Americans use each year?

______ 1 million tons _______ 1 million pounds
______ 5 million tons _______ 50 million tons

8. How many tons of solid waste did Vermonters produce in 1987?

_______ 10,000 _______ 50,000 _______ 500,000 _______ 5 million

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SCHOOL TRASH ANALYSIS

TRASH ANALYSIS-WASTE BASKET SAMPLE-DATE:

ALL WEIGHTS IN GRAMS

AREA	TOTAL WT.	PLASTICS	W.PAPER	C.PAPER	GLASS	FOOD	Al	Fe	DEPOSIT	CARDBOARD
TOTALS										

SCHOOL TRASH ANALYSIS 7-8 ● I.A.2

Concept
Analyzing the source and content of a waste stream is the first step in learning how to reduce, reuse and recycle.

Objective
Students will analyze their waste producing habits in order to begin changing them.

Method
Students will survey the waste produced in their school.

Materials
School map, triple beam balance, containers to hold trash on scale, lab tongs, standard trash container (brown paper bag would do).

Subjects
Math, Social Studies, Science.

Skills
Measuring, classifying, recording and interpreting data.

Time
Day one (80 minutes), day two (80 minutes), day three (80 minutes).

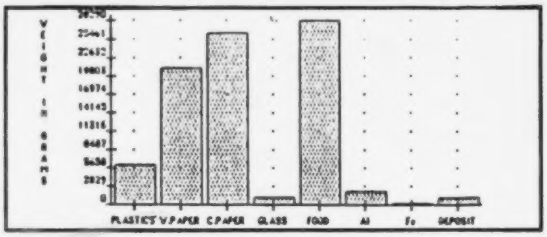
Source
Brian Slopey, U-32 High School, East Montpelier.

AVR Guide Resources
PARALLEL ACTIVITIES
K-3 ● I.A.1 Garbage Bag Recipe;
4-6 ● I.A.1 Litter Search.

INFORMATION
I.A.1 The Solid Waste Stream.

RESOURCES
A.12 Environmental Education;
C.4 General.

BACKGROUND
This chart illustrates the results of the U-32 School Trash Analysis, as conducted by Brian Slopey and his 7th grade class in the spring of 1988. In the study, students calculated that up to 93% of U-32's trash could be recyclable. If you'd like more details on his procedure or the results of the study, contact Brian at U-32.



LEADING QUESTION
What are all the things we throw away?

PROCEDURE
DAY ONE

1. Give the class about ten minutes to brainstorm a list of things we throw away. As they are listing things, have them think about whether the items are recyclable and/or pollute (air, land or water). Discuss the results as a whole class.

2. Distribute "Overview of the Waste Problem." Read the overview and discuss the meaning of the vocabulary words.

3. Tell the students that they are members of a research team that is going to take a look at waste habits of the school and offer recommendations on the findings. Hand out "School Building Trash Analysis" to help explain the project.

DAY TWO

1. Following the directions on the "School Building Trash Analysis," have students collect and sort trash from different places in the school. All data should be recorded on a class chart and/or computer spreadsheet.

DAY THREE

Students answer the questons on "Analysis of the School's Trash" as individuals, in groups or as a whole class.

EVALUATION
Worksheets.

EXTENSIONS
A. Act upon the recommendations for solving school waste problems made by the class.

B. Find out what the shool is paying for waste disposal. How much money could be saved by recycling and/or composting instead?

C. Have class investigate amounts of household wastes from other sources (own homes, surveys, regional solid waste districts, etc.). How can wastes be treated in the various situations?

Vocabulary: See handout.

OVERVIEW OF THE WASTE PROBLEM

Vermont, the United States, and most of the world are now facing a waste problem of huge proportions. It is estimated that every person in the United States produces 1,930 pounds of household waste per person each year. (As large as this number is, it does not include all the other wastes we dispose of, such as factory and transportation wastes.) This is by far the most waste per person from any country in the world, and so we are truly the most wasteful group of people in the world. Not only does this lifestyle use up valuable resources that future generations might need, but it also threatens to pollute our land, water and air which can only result in less healthy human beings.

However, when one looks at how we live and what waste we produce there is hope that we can change some of the ways we live and leave a healthier environment. for instance, it is estimated that we could recycle 40-50%, compost 25-30%, and reduce waste 5-10%. ***AN EFFORT SUCH AS THIS COULD REDUCE THE WASTES WE SEND TO THE LANDFILL BY 70-90%!!*** There are also many chemicals and other products we use that are simply not necessary. If we decide not to use many of these substances we will each be reducing the amount of waste and pollution that is entering the earth's ecosystem.

Waste Terms To Understand:

POLLUTION (Air, Water, And Land)
RECYCLABLE
COMPOSTABLE
RENEWABLE RESOURCE
NONRENEWABLE RESOURCE
PLASTICS
PAPER
GLASS
METALS
SEWAGE
OIL
FOOD
PESTICIDES
GROUNDWATER
BIODEGRADABLE
CONSERVATION
TOXIC WASTES
MARINE POLLUTION
INCINERATION
LOVE CANAL
OZONE LAYER DEPLETION
RADIOACTIVE WASTES
FERTILIZERS
ACID RAIN
WILLIAMSTOWN VS. INTERSTATE UNIFORMS (or similar local situation)

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Name: **Date:**

SCHOOL BUILDING TRASH ANALYSIS

You are a member of a research team that is responsible for sampling the school environment in order to understand its waste habits. You will be assigned one area in which to collect waste samples. These waste samples will be brought back to the lab for analysis. Follow the following procedure step by step very carefully:

1. Obtain the proper size trash container.

2. Go to your area of the school.

3. BE VERY QUIET AND POLITE. Collect a trash container full of trash.

4. Go back to the lab.

5. Sort your trash according to the data charts.

6. Weigh out each kind of trash and record this on your data chart.

7. Record your data on the class chart.

8. Make a list of items found in each category of trash.

9. Using the class chart, copy the data from other teams on your data tables.

10. After filling out "ANALYSIS OF THE SCHOOL'S TRASH," answer the following questions:

a. Considering the data you have collected, explain what you think our school should do about its wastes. Why do you feel this way?

b. Using a map of the school, show where we could set up recycling stations. Also explain how you believe recycling could be achieved. Tell what jobs each member of our school community (students, teachers, principals, custodians, cafeteria workers, etc.) could do to make recycling a reality (also include school groups such as student council, honor society, etc.)

c. Since not all of our school's trash ends up in trash cans, explain ideas that you have for keeping the floors of our school clean.

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SCHOOL TRASH ANALYSIS 7-8 ● I.A.2

Name: **Date:**

ANALYSIS OF THE SCHOOL'S TRASH

You have now had a chance to examine the data you have collected. This data is useless unless we are able understand what it means and how we can use it to improve our school. Answer the following questions to help focus your concentration:

1. What area of the school produces the most trash?______________
2. How much trash does the school produce each day?______________
3. What area of the school produces the least trash each day?______________
4. What is the most common kind of trash?______________
5. What is the least common kind of trash?______________
6. What percentage of our trash is recyclable?______________

add up those materials that are recyclable

________material =________grams
________material =________grams
________material =________grams
________material =________grams
________material =________grams
+ ________material =________grams
________material =________grams

____

divide the number you just got by the total weight of materials

recyclables weight in grams________ | total weight in grams________

multiply this answer by 100

____
x ________
________% recyclable

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POTATO CAKES

7-8 ● I.A.3

Concept
Excessive packaging and processing uses up limited natural resources and increases the amount of solid waste requiring disposal.

Objective
Students will examine the complexities of food processing and packaging and will consider ways to reduce use of energy and resources.

Method
Students will survey different food products.

Materials
Attached handouts.

Subjects
Language Arts, Social Studies, Environmental Education.

Skills
Describing and comparing, inferring, problem solving.

Time
One class, outside assignment.

Sources
Recycling Study Guide; A Way With Waste.

AVR Guide Resources
PARALLEL ACTIVITIES

K-3 ● I.A.3 Too Much Packaging?;
4-6 ● I.A.3 The Story of...;
9-12 ● I.A.2 Packaging Preferences.

INFORMATION

I.A.7 Packaging.

RESOURCES

B.4 Industry Associations;
C.8 Plastics and Packaging.

BACKGROUND
In 1974, the Environmental Action Foundation published research showing that the energy used to produce the packaging used annually by McDonald's fastfood restaurants was equal to the amount of energy required to supply Boston, Washington, San Francisco, and Pittsburgh citizens for one year.

LEADING QUESTION
Could we save energy and natural resources by choosing one product or packaging over another?

PROCEDURE

1. Examine the list of 21 different potato products. Discuss the questions on the handout or have students fill them out.

2. Working in pairs and using a chart similar to the potato chart, have students choose a form of fresh food to investigate at a local grocery store.

3. After the investigation, have students meet in small groups to discuss their results. Then each group reports to the teacher for class discussion.

EVALUATION
What percentage of the cost of packaged foods do you think is due to packaging? Which of your favorite foods could you buy without packaging? How could food packaging be reduced?

EXTENSIONS

A. Take a field trip to a coop. Compare the different product choices, packaging, sales methods, and philosophies between conventional and cooperative shopping.

B. Research differences in nutritional value between the different foods discussed.

C. Discuss the influence of advertising and packaging design on purchasing decisions.

D. Develop a list of commonly used plastic packaging types. Have the students figure out what was used for the same purpose before plastic was readily available. What are some of the pros and cons of the two types?

E. Discuss the raw materials for packaging - are these renewable? Emphasize the amount of plastic used - what will happen to plastics? Why do they pose a more difficult problem?

Vocabulary: packaging, food processing, natural resources, energy.

POTATO CAKES

NAME: **TYPE OF PRODUCT:**

1. Which forms of the product are most highly processed and packaged?

2. Which are most expensive per pound?

3. Which form of product would you purchase if you were interested in reducing solid waste?

4. Which form of the product would you purchase if you were interested in saving money?

5. Which form of packaging do you think:

a) uses the most energy?

b) saves the most energy?

6. What are the relationships between cost and the amount of packaging and processing in a product?

7. What conclusions can you make about these relationships?

8. Looking at the product form with the most packaging, is all this packaging necessary?

9. Which packaging:

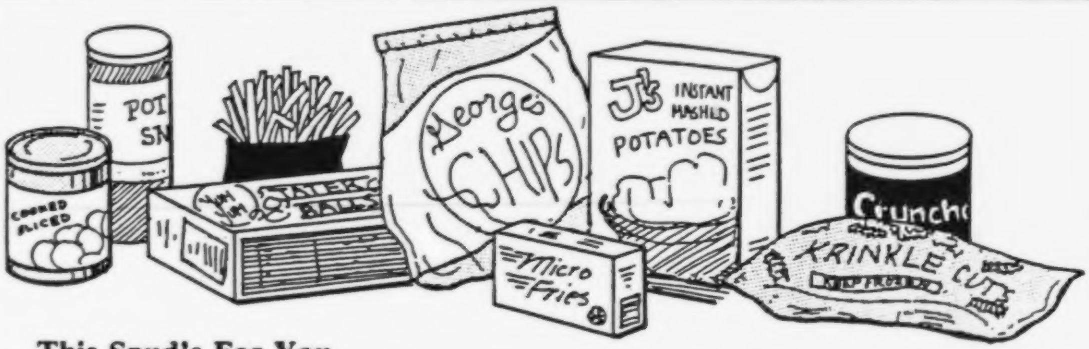
a) weighs the least per pound of product;

b) takes up the least space in the landfill;

c) decomposes most or least quickly;

d) doesn't produce toxic materials when it breaks down?

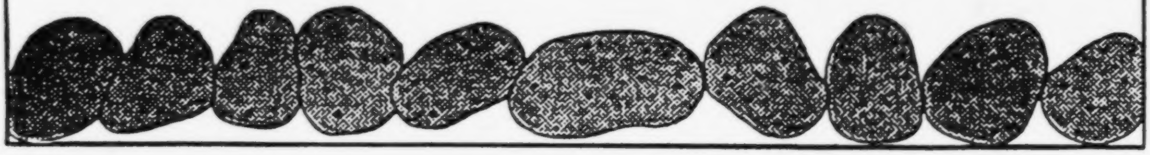
10. Which of these products will you buy in the future? What criteria will you use for making your decisions about what to buy and what not to buy?



This Spud's For You

Product★	Package Size	Price	Price per Pound
Fresh Idaho Potatoes	10 lb.	$2.99	$ .30
Fresh Idaho Potatoes	5 lb.	1.98	.40
Fresh Idaho Potatoes	loose	.59	.59
Kohl's Canned Sliced Potatoes	8.5 oz.	.33	.62
OreIda Tater Tots	4 lb.	2.99	.75
OreIda Tater Tots	2 lb.	1.69	.85
OreIda Tater Tots	1 lb.	.99	.99
Kohl's Crinkle Cut French Fries	5 lb.	2.99	.59
Kohl's Crinkle Cut French Fries	2 lb.	1.33	.67
MicroMagic Microwave French Fries	15 oz.	1.69	1.80
MicroMagic Microwave French Fries (3-3 oz. pkgs.)	9 oz.	1.25	2.22
Small Order McDonald's French Fries	2.5 oz.	.59	3.78
Betty Crocker Potato Buds	28 oz.	2.59	1.48
Betty Crocker Potato Buds	13.75 oz.	1.49	1.73
Betty Crocker Potato Buds	5.5 oz.	.65	2.08
Planter's Potato Crunchies	6.5 oz.	1.19	2.54
Durkee Potato Sticks	7 oz.	1.49	3.41
Durkee Potato Chips (8-9/16 oz. pkgs.)	4.5 oz.	1.29	4.59
Pringle's Potato Chips (reg.)	7.5 oz.	1.49	3.18
Jay's Potato Chips (twin pack)	8 oz.	1.39	2.78
Jay's Potato Chips (12-0.5 oz. pkgs.)	6 oz.	1.89	5.04

★All items priced on June 22, 1987, at Kohl's II Food Stores and McDonald's in Madison, WI.



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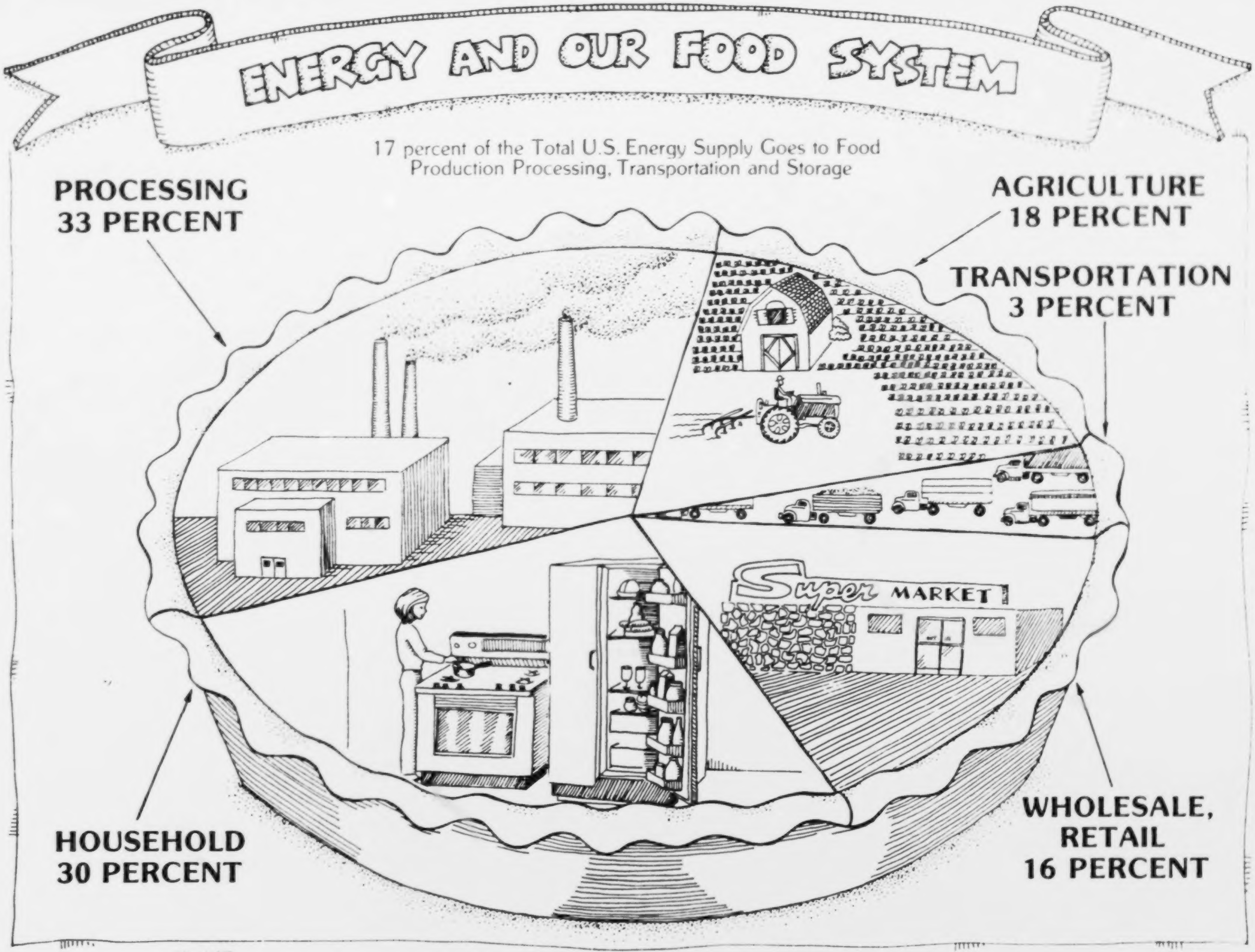
POTATO CAKES

7-8 ● I.A.3

ENERGY AND OUR FOOD SYSTEM

17 percent of the Total U.S. Energy Supply Goes to Food Production Processing, Transportation and Storage



National Center for Appropriate Technology; Sophie Diven, illustrator.

RESOURCE PROTECTION GAME

7-8 ● I.B.1

Concept
Human intervention impacts areas of our environment in a variety of ways.

Objective
Students will identify the ecological impacts of some solid waste management practices on natural resources.

Method
Students will play a game.

Materials
Natural resource cards (one per group).

Subjects
Science, Social Studies.

Skills
Communicating, formulating questions, problem solving.

Time
One class, extension: 2-3 classes.

Source
Oscar's Options.

Resources
Dr. Seuss. *The Lorax;* Lawrence Pringle, *Ecology;* any literature discussing ecosystems, cycles, interdependence.

AVR Guide Resources

PARALLEL ACTIVITIES
4-6 ● I.B.2 The Lorax;
9-12 ● I.B.1 Nonrenewable Resources; 9-12 ● I.C.5 GNPP.

INFORMATION
I.B Waste and Natural Resources.

RESOURCES
A.11 Environmental Groups;
B.5 Environmental Groups;
C.1.d Environmental Education;
C.4 General.

LEADING QUESTION

How do our activities impact on our environment?

PROCEDURE

1. As an introduction, review the earth's natural cycles, human interruptions and alternatives. Using one of the given situations or a specific local example, demonstrate how each of the natural resources are affected and discuss alternatives to the situations.

2. Divide the class into six groups. Distribute natural resource cards and have a spokesperson from each group read about the resource to the rest of the class. Each group is to be responsible for protecting that resource.

3. Read individual situations to the class and list them on the board. Ask each group to answer the following questions in terms of their resource and each situation.

   a. How does this situation help your natural resource?

   b. How does it harm your natural resource?

   c. Is this a good situation or a bad situation? How might it be improved? What possible alternatives would be better?

EVALUATION

Successful involvement of students and resolution of issues.

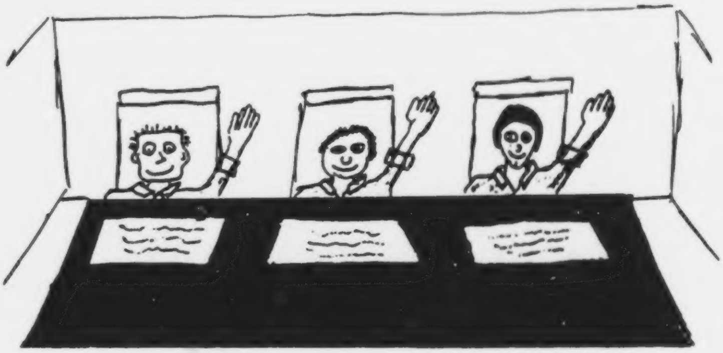
Vocabulary: natural resources, interdependence.

EXTENSIONS

A. Distribute copies of all natural resources and situation cards to each student. Have each student write an essay addressing the effects of one situation on all natural resources or one natural resource by each situation.

B. Conduct a debate or panel discussion or simulate a zoning board meeting. Students brainstorm a variety of individual positions, choose a position to role play, research and gather information on the position, and defend the position in debate. Using the ski development expansion, possible positions and concerns are as follows:

- **Neighboring farmer** and/or homeowner (lost privacy and pollution)
- **School board member** (impact on school population)
- **Town selectmen**/chamber of commerce (impact on employment, tax $, traffic)
- **8th grade ski club** (entertainment physical education)
- **Ski developer** (money)
- **Environmentalist,** Vermont Dept. of Water Resources (impact on environment)
- **Audubon Club** (destruction of wildlife habitat)
- **Legislator**



Newark Street School, West Burke

NATURAL RESOURCE CARDS

AIR

Clean air is needed by all forms of life. Any smoke or chemicals which enter the air cause air pollution. Protect the air from any and all forms of pollution.

WATER

Fresh water has two important jobs. It is home to many life forms and living creatures must drink it to survive. Salt water also supports many forms of life. Protect both kinds of water.

SOIL AND MINERALS

Soil nurtures all forms of plant life. It contains the minerals and nutrients needed by all living things. There is a limited supply of minerals on the earth. Protect the soil and its minerals.

FORESTS AND PLANTS

Plants are an important natural resource. They are beautiful. They help purify our air through the oxygen they give off in photosynthesis. We need plants for food and medicine. Plants are also a source of food and shelter for animals. Protect the plants and the forests.

WILDLIFE, FISH, BIRDS, AND INSECTS

Fish and wildlife give us many foods and other products. They provide recreation such as nature study and fishing. Many birds and insects pollinate our fruits and vegetables. We must protect them.

PEOPLE

Are human beings a natural resource? We are part of many food chains. We affect the ecological balance of the earth. We consume natural resources. Think about what is best for the people today. Plan for the future generations who will inherit the earth from us.

SITUATIONS

1. A MANDATORY CURBSIDE RECYCLING PROGRAM has just begun in your town. Residents must separate their newspaper, aluminum, steel cans, and glass for recycling, and set them out with their other trash. It is now illegal to send bags of leaves and yard waste to the landfill.

2. A local CHEESE FACTORY produces several hundred pounds of whey waste each week. The milk haulers dump the whey illegally in local swamps, streams, and on unused fields when they think no one is looking.

3. The local SKI DEVELOPMENT has decided to expand by constructing three more lifts, adding snow-making equipment and building 360 new condominium units.

4. WATER POLLUTION After heavy rains, untreated sewage and rainwater contaminated with automobile oil flow directly into Lake Champlain and other water bodies used by Vermonters for recreation and drinking water.

5. HAZARDOUS WASTE A print shop generates 40 lbs. of chemical waste each month which does not have to be reported to the state or disposed of with other regulated hazardous wastes. The print shop operator waits till he a couple 55-gallon drums of the stuff and then dumps them at the local landfill.

6. LITTERING A fishing party was out on Lake Champlain. By the end of the day, their inexpensive styrofoam cooler had disintegrated into several pieces. It, along with beer bottles, plastic sandwich bags and orange peels were conveniently discarded overboard before the end of the trip. One of the fishing lines also got caught on the motor; both tangled line and lures were lost in the lake.

7. A NEW LANDFILL The municipal landfill for your town is scheduled to close in six months. The town has decided to build a new landfill on the other side of town.

8. INCINERATION A trash to energy incinerator plant is being built in a nearby town. This plant will supply your town with some of its electricity and be the disposal facility for your waste. Some of the ash produced may be toxic and will be deposited in your town's landfill.

HOW HAS SOLID WASTE CHANGED OVER TIME?

TRASH TIMELINE

7-8 ● I.C.1

Concept
What we throw away reflects our own personalities as well as that of the society in which we live.

Objective
Students will consider and classify various forms of evidence in the study of their own and a past culture.

Method
Students will keep records of the solid waste they produce in a day, and will compose hypothetical lists for other characters in history. The class will play a game of charades to determine the identity of an historical character by what he/she has thrown out.

Materials
The attached handout cut up into separate cards.

Subjects
Social Studies, Language Arts.

Skills
Inferring, creative thinking, researching.

Time
One class period.

Resources
"The Amazing World of Trash," *National Geographic*, (April, 1983); Lawrence Pringle, *Throwing Things Away*. Kathleen Deagan, "Tracing the Waste Makers." *Archeology*. (January/February 1989); Le Projet Du Garbage, Anthropology/BARA, University of Arizona, Tucson, AZ 85721 (602) 621-6290.

AVR Guide Resources
PARALLEL ACTIVITIES
K-3 ● I.C.1 Grandparent's Toys;
9-12 ● I.C.2 Then and Now;
9-12 ● I.C.3 The Dump Ground.

INFORMATION
I.C Waste and Society.

RESOURCES
C.4 General.

BACKGROUND

> *Archeologists have long used refuse from ancient cultures to reconstruct behavior; modern household garbage is no less a reflection of the behavior of those who have generated it.*
>
> -- Archeologist William Rathje, University of Arizona

LEADING QUESTION
What can the waste we produce tell us about ourselves?

PROCEDURE

1. Ask the students to keep a journal of everything they throw out over a 24-hour period. Explain that we don't usually notice all the stuff we throw out. (This is part of the solid waste problem, because we aren't conscious of how much and what we throw away.) Solid waste experts study what we throw out to try to start solving our problems.

2. Archeologists also study what societies all through history have discarded in order to learn about the people who created the waste. Announce that the class is going to become an archeological team.

3. Break the class up into four groups and pass out three character cards to each. Have each group research their characters and brainstorm a garbage composition list of six items for each one.

OPTION: Teachers can choose characters from other topic areas studied that year. When the lists are complete, have the first group read their list for one character. List one garbage item at a time until one of the other groups has been able to guess the identity of the character. Move on to the next group until all the character cards and garbage lists have been identified.

4. Discuss what kinds of things you can tell about a culture and about a person from studying its waste. How has the waste we have produced changed over time?

EVALUATION
What does your own list tell you about yourself and about our society? How do archeologists use their findings to determine characteristics of a culture?

EXTENSIONS

A. Compose a landfill garbage composition list for an imaginary civilization which reflects some of the civilization's characteristics.

B. Have students list items they would bring on a picnic lunch. If Columbus (or another character in history) had the same meal, what would still be around today?

C. Keep a garbage journal for a character in history or in your imaginary civilization describing what he/she does and throws out in a day.

Vocabulary: archeology, trash composition.

CHARACTER CARDS

Neanderthal	Roman soldier	Aztec priest
Abenaki Indian 1700	Benjamin Franklin	Vermont Farmer 1890
New York City resident 1860	Thirteen-year old girl 1956	Five-year old boy 1988
Corporate executive 1988	Students Choice	Teacher's Choice

ART REFLECTING THE ENVIRONMENT 7-8 ● I.C.2

Concepts
Each of us is responsible for the waste stream. The waste a society produces, like the art it produces, tells us a lot about its values.

Objectives
Students will understand the visual artist as a recorder of history and ideas, identify society's impact on artistic expression and the potential ways in which artistic expression can impact society, and use the visual medium to express their own values.

Method
Students will compare existing art and will create art expressing their own environmental ethic.

Materials
Fine art picture books and current magazines.

Subjects
Art, Language Arts, Social Studies.

Skills
Analyzing, describing and comparing, observing, valuing.

Time
One class initialy art work can be extended.

Resources
Carolyn Jabs, *RE/USES*; "The Amazing World of Trash", *National Geographic*; Barbara Kataoka Slavin, *Pictures and Pollution*; Vermont Council on the Arts; local artists.

AVR Guide Resources
PARALLEL ACTIVITIES

K-3 ● I.C.2 Impressions with E. B. White;

9-12 ● I.C.1 Shopper Survey.

INFORMATION

III.A Redesign and Reuse.

RESOURCES

C.1.c Reuse Activities.

BACKGROUND

In May 1983 the artist Christo, with 430 helpers, created 'Surrounded Islands' -- surrounding eleven small islands in Miami's Biscayne Bay with floating skirts of bright-pink plastic fabric. After two weeks the artwork was dismantled, and 6.5 million square feet of polypropylene went to the landfill.

-- Lawrence Pringle, *Throwing Things Away.*

LEADING QUESTION
Why do people create art? What is the difference between "art" and "waste"?

PROCEDURE

1. Sequentially display at least 20 different examples of artwork which illustrate the following: environmental art, love of natural environment, consumer society and American values, current american life, typical American life 100-200 years ago, political propaganda, etc. Ask students to write key words expressing their immediate responses to the pictures.

2. As a class, discuss the impressions. What is the purpose of art? What can art tell us about the person who created it and/or the society/environment in which it was created? Can art influence society/history? Why do we create art? What is the difference between "art" and "waste"?

3. Ask the students to isolate one issue or observation about contemporary society about which they feel strongly, and using the visual medium, express their viewpoint/emotion/observation.

EVALUATION
Repeat the activity with student art. Discuss possible connections between what the students believe and what emotions their artwork evokes.

EXTENSIONS

A. Students could select one artist to explore in depth, reporting on the artist's style and philosophy, impact on society, cultural and historical background.

B. Students could write poems using descriptive words to match a piece of artwork.

C. Create trash sculptures.

Vocabulary: environmental art.

WASTE WALK 7-8 ● II.A.1

Concepts
Littering is improper waste disposal. Education and publicity can help prevent it.

Objective
Students will document and categorize litter in their neighborhood, and will brainstorm ways to get people to stop littering.

Method
Students will photograph and collect local litter.

Materials
Bags for collecting litter, litter survey charts, cameras, film, poster board, glue.

Subjects
Art, Language Arts, Science, Math, Social Studies, Photography.

Skills
Measuring, describing, categorizing, observing, problem solving.

Time
Three full classes - one outside, one in small groups processing, one class discussion.

Source
Workshop.

Resources
Larence Pringle, *Throwing Things Away*.

AVR Guide Resources

PARALLEL ACTIVITIES
K-3 ● II.A.3 Litter Garden;
4-6 ● II.A.2 Plastic Litter.

INFORMATION
II.A.3 Litter.

RESOURCES
C.1.a Solid Waste and Recycling;
C.4 General.

BACKGROUND
Sometimes we may not be aware of how much litter there is until we consciously look for it. Once we become aware, however, it's ugliness may motivate us and others to dispose of it properly.

LEADING QUESTION
What is litter?

PROCEDURE
1. Interview a person familiar with litter collection before the bottle deposit law.

2. Break the class up into small groups or pairs and assign a local strip of road for each to survey.

3. Have each student take pictures of the litter in its "natural" surroundings. Each strip should be documented for types and number of pieces of litter found. Then have the students collect all the litter in their strip.

4. Weigh total litter collected and compare results of collection from other strips in different parts of town and on different types of roads. Make projections to determine amount of litter generated and requiring clean-up each year. What is the per-mile average of litter objects collected in the area?

5. Brainstorm a variety of ways to categorize the litter. Define terms such as resource base, biodegradable, disposable, recyclable, nonrenewable, organic, human-made, deposit containers, etc. Create litter composition charts documenting the different categories or graph the results. (Glass, Aluminum, Plastic, Paper, etc.) Compare the amount of deposit to non-deposit containers found.

6. Brainstorm ways to help people stop littering and start an anti-littering campaign. Illustrate the problem by creating a photographic display of the litter survey along with litter statistics to post in the school or community. Write poems to accompany the photographic displays. Make a slide show of garbage pictures to match the Pete Seeger song, "Garbage," or other similar song.

EVALUATION
Define and categorize litter. Define vocabulary words. How does litter vary from place to place? How can we reduce litter?

EXTENSIONS
A. Investigate bottle bill legislation and Green Up Day and their effect on roadside litter.

B. Utilize trash collected to make mobiles, three-dimensional collages, sculpture or other creative displays of types of trash found at certain locations.

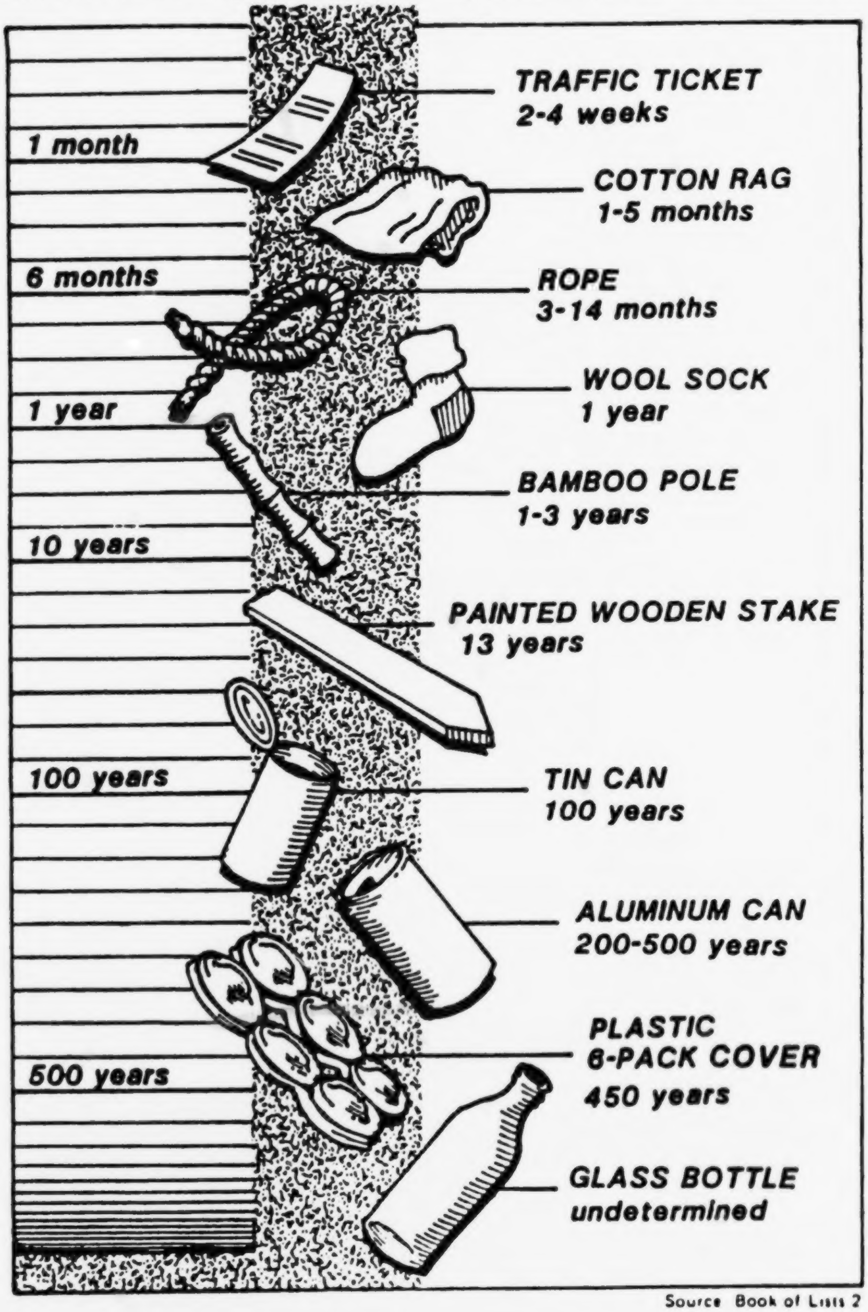
C. Make mobiles or posters to illustrate trash categories or vocabulary.

D. Illustrate trash idioms/expressions: "Dump on someone, wasting time," etc. and proverbs: "Waste not/want not, etc."

Vocabulary: littering, biodegradable, organic, human-made, resource base, recyclable, disposable.

Enduring Litter

Litter at the roadside is ugly. How long it will stay before decaying may be an ugly surprise.



Source: Book of Lists 2

HOW CAN WE RECOVER RECYCLABLES FROM WASTE?

RECOVERING RECYCLABLES

7-8 ● II.A.2

Concept
It is far more complicated and expensive to remove recyclables from the waste stream than to separate them at their source.

Objective
Students will devise materials recovery systems for recovering recyclables from the waste stream.

Method
Students will design a model of a materials recovery facility.

Materials
Magnets, water-holding containers, screens of different sizes, strainers, mixed garbage with floatables, magnetic and different sized particles.

Subject
Science.

Skills
Designing, experimenting, sorting and classifying.

Time
One or two class periods.

Sources
Brian Slopey, U-32 High School, East Montpelier; Workshop; *Biocycle* (January 1988).

Resources
Recycling: Wealth Out of Waste (film) (C.3); *PRF: Strategic Vision* (video).

AVR Guide Resources

PARALLEL ACTIVITIES
7-8 ● III.B.1 Source Separating;
9-12 ● III.B.2 Collecting and Sorting.

INFORMATION
II.A Transportation and Processing;
III.B Recycling.

RESOURCES
A.9 Recycling Businesses;
C.5 Recycling.

BACKGROUND

Proponents of MRFs point to three principal reasons for their attractiveness. Because the feedstock of MRFs is co-mingled recyclables . . . it makes it easier for citizens to participate. That translates into higher volumes of materials taken from the solid waste stream. Again, because of the co-mingled nature of the recyclables, collection equipment needs can be simplified. There is no need for vehicles with four, five or six compartments; at most, two are required. Collection times and costs can be held to a minimum because less time is spent at the curb sorting materials or emptying several containers. Finally, most advocates believe that materials processed through MRF are more marketable. They feel that they can better meet industry standards and that the high volume of material that they can generate help to assure a market.

--Jim Glenn, *BioCycle* (January 1988)

LEADING QUESTION

How can mixed trash be separated for recycling?

PROCEDURE

1. Take mixed trash and discuss. Mention that this trash contains valuable resources. It would have been easier to separate them out at the source, but it can still be done.

2. Explain that:

a) magnets could be built on large scale for taking out iron-containing substances,

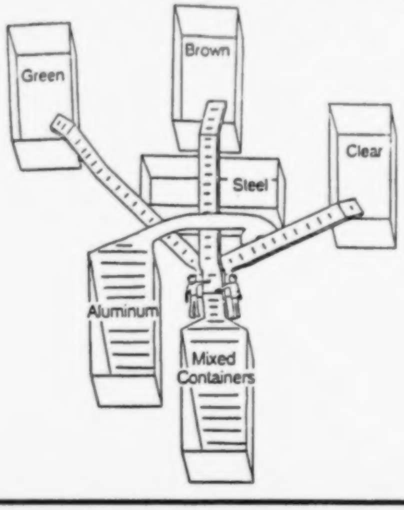
b) light objects could be floated or blown away from other materials,

c) screens can separate the remaining material using different size sieves.

3. Have students design and construct a mini-materials recovery system.

EVALUATION

Students display and explain their mini-materials recovery systems.



Vocabulary: materials recovery facility.

RECOVERING RECYCLABLES

EXTENSIONS

A. Compare MRF designs with those for source separation. See 7-8 O III.B.1 SOURCE SEPARATING.

B. Investigate one of the following commercial materials recovery systems companies and their projects:

Monmouth Recycling Corp.
492 Joline Ave.
Long Branch, NJ 07740
201-870-0933
Contact: Richard Rosen

New England CRInc.
74 Salem Road
North Billerica, MA 01862
617-667-0096
Contact: Hal McGaughey

R.E.I. Distributors, Inc.
510 Old Bridge Turnpike
South River, NJ 08882
201-238-7600/
Contact: Simon Sinnrich

Resource Recovery Systems
PO Box 501
Old Lyme, CT 06371
203-434-9635
Contact: Peter Karter

TRASH HAULERS

7-8 ● II.A.3

Concept

Waste haulers' rates depend on their costs and the variety of services they provide.

Objective

Students will investigate the efficiency and costs of solid waste collection and will determine the advantages and disadvantages of operating a recycling business and/or curbside recycling program.

Method

Students will interview waste haulers and recycling businesses.

Materials

Copy of Act 78.

Subjects

Math, Social Studies, Economics.

Skills

Researching, interviewing.

Time

Variable.

Resources

Local waste haulers, local recyclers, town and city officials.

AVR Guide Resources

PARALLEL ACTIVITIES

K-3 ● II.A.1 Taking Trash Away;
4-6 ● II.A.1 Hauling It Away.

INFORMATION

II.A. Transportation and Processing;
III.B Recycling.

RESOURCES

A.3 Solid Waste Districts;
A.4 Transfer Stations.

BACKGROUND

Waste hauling is a business which may serve residential, commercial and industrial customers. This business involves administrative, equipment, labor, transportation, and landfill fee costs. Individuals or businesses use a waste hauler or pay these costs themselves to transport their waste (e.g. a business may own and operate its own dump truck for earth moving which it uses to transport its waste; an individual drives his/her waste to a transfer station on the way to work). The collection of waste in a systematic manner and its transportation and compacting or sorting in specially designed vehicles can realize economies of scale, using fewer nonrenewable resources and having less environmental impact than transportation by individuals. Besides general inflation, rising costs for waste haulers have lately been influenced by a dramatic increase in landfill fees, after the passage of Act 78. As well, State regulation for planning and environmental safety reasons, also a result of Act 78, has also increased hauler costs (e.g. requirements that haulers license each of their trucks ($10 annual fee) and designate which waste facilities they have access to). Hence, haulers have recently increased the amount they charge their customers.

LEADING QUESTION

How much does waste disposal cost?

PROCEDURE

1. Discuss the costs of collecting and transporting trash in your community. How might these costs vary throughout the state? Has that cost changed recently? Why? How much trash is produced each week? How many local waste hauling businesses are there? How many residents and businesses are served?

2. Ask a local waste hauler to come talk to the class.
   How many trucks do you own/operate?
   What kind of trucks are they?
   How much does that kind of equipment cost?
   Why is the equipment designed the way it is?
   How many truckloads of trash do you collect each day?
   How is the refuse measured?
   How many houses and or businesses do you collect from?
   Where is the trash taken and what are the tipping fees there?
   How many miles do you cover each day? each year?
   Would you ever consider operating a recycling curbside service?
   Why or why not? What would it involve?
   What effect has ACT 78 had on residents/your business/town?

3. Interview someone from a voluntary recycling program or a recycling business.
   What are their costs?
   How much voluntary labor does the program depend upon?

(continued on next page)

Vocabulary: trash hauler, collection, disposal, ACT 78.

TRASH HAULERS

4.On the basis of the interviews, have the class determine all the costs involved in collection and transport of waste. Include equipment, mileage, salaries, tipping fees, etc. incurred in a waste hauling business. Discuss the reasons waste haulers may or may not be interested in curbside recycling. What added expenses would there be to their businesses? Who would pay these costs? What about recycling programs?

EVALUATION

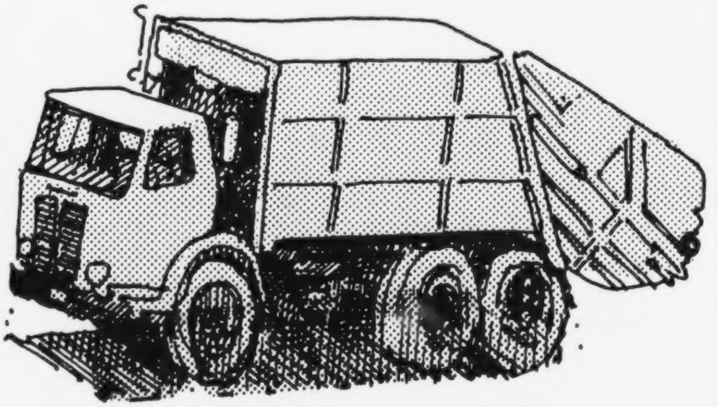
Display information. Write an article for the school paper.

EXTENSIONS

A. Take a field trip to a transfer station, landfill and/or recycling center.

B. Determine costs for waste collection and transport for the school for a year. Determine how much paper and/or organic wastes the school produces and devise a recycling or composting program which will help the school save money by reducing disposal costs. See 7-8 O I.A.2 School Trash Analysis.

C. Design a vehicle which can pick up trash and sorted recyclables.



MINI-LANDFILLS

7-8 ● II.B.1

Concept
90% of solid waste is currently disposed of in landfills.

Objective
Students will learn how a sanitary landfill is made and operates, and will understand some of the associated pollution problems.

Method
Students will construct a small scale replica of a sanitary landfill.

Materials
One five gallon ice cream container and two lids, one used; clear plastic bag large enough to fit in the ice cream container; three bricks.

Subjects
Science.

Skills
Observing, recording, safety goggles, graphing.

Time
One hour the first day, 10-15 minutes each day thereafter for two months.

Sources
Garbage Reincarnation; Pavoni, Hagerty, & Heir, *Preserving Man's Enviornment.*

Resources
Local landfills; ANR, State of Vermont Solid Waste Rules; ANR, State of Vermont Solid Waste Plan.

AVR Guide Resources

PARALLEL ACTIVITIES

4-6 ● II.B.1 Landfills;
7-8 ● II.B.2 Landfill Soil;
9-12 ● II.B.1 New Landfills;
9-12 ● II.B.2 Methane.

INFORMATION

II.B.2 Landfills;
II.C Public Planning and Policy.

RESOURCES

A.3 Solid Waste Disticts;
A.5 Landfills.

LEADING QUESTIONS
What are some of the possible hazards that might result from an improperly designed landfill?

PROCEDURE
1. Cut four or five large circles, squares and triangles out of the sides of the container.

2. Make one straight cut in the lid from the rim to the center.

3. Cut a half-inch hole in the center of the lid and another in the center of the bottom of the ice cream container.

4. Fold the ice cream container top together so the ends overlap, and put it down into the bottom of the carton.

5. Pull a corner of the plastic bag out through the two holes (one in the top and one in the bottom of the container) eight to ten inches. This will act as a reservoir for the leachate.

6. Fill the container daily with layers of small pieces of the following: scraps from your lunches, leaves from the school yard, paper, glass, aluminum, steel, bi-metal, plastic, and maybe some oil. The material should be put in at a ratio of four parts waste to one part dirt. A good rule to follow would be one inch of waste covered by 1/4 inch dirt. Remember to always cover the waste with dirt and pack it down lightly. (To really simulate a landfill, use clay or glacial till as cover as it is less permeable.) Sprinkle a small amount of water on the landfill after each layer of waste and dirt is added.

7. Fill the mini landfill one-half to three-quarters full. Place it on three bricks so there will be space under the container for the corner of the plastic bag to fill with leachate.

8. Water occasionally to simulate rain, but don't overwater. Try to reproduce the conditions that exist for a real landfill.

9. When the mini-landfill is complete, use the second top to cover the container and let it sit for at least two months.

10. After two months have passed, collect the leachate that ended up in the corner of the plastic bag. Empty the contents of the mini-landfill to see which items decomposed and which did not.

EXTENSIONS
A. Test a sample of leachate for acidity. See handout.

B. Research why leachate needs to be controlled at landfills. What materials leach from landfills?

Vocabulary: leachate, sanitary landfill.

Testing Leachate

To determine how leachate, once it has reached the aquifer, contaminates groundwater, conduct the following experiment:

Materials Needed:

- 4 petri dishes
- 4 steel nails
- soap
- rubbing alcohol
- paper towels
- universal indicator paper
- a sample of leachate*
- household ammonia
- household vinegar
- tap water
- safety goggles

1. Measure the acidity of the leachate with universal indicator paper. Compare it with indicator dipped in tap water, in household ammonia, and in household vinegar.

2. Clean the nails with soap and water, rinse with alcohol and dry with paper towels. Be careful not to touch the nails with bare hands after rinsing.

3. Fill each of four petri dishes about half-full; place tap water in one, leachate in another, household ammonia in the third, and vinegar in a fourth. Place one nail in each dish.

4. After a few days, when the liquid has evaporated, observe the nails. Record the observations. Have the nails changed in appearance?

5. Discuss results in relationship to landfill management. Why do we need to try to control the amount of liquid in a landfill? Under what conditions do metals leach? What other materials leach under the conditions found in a landfill?

* An easy way to produce leachate is to take mixed trash, drain water through it and collect the resulting liquid.

Adapted from Joseph L. Pavoni, D. Joseph Hagerty, and John E. Heer, Preserving Man's Environment. Copyright (c) 1974 by Data Courier, Inc., Louisville, Kentucky.

LANDFILL SOIL

7-8 ● II.B.2

Concept
By carefully analyzing different environmental, social, and economic factors, communities may select the most appropriate and least harmful method for disposing of solid waste.

Objective
Students will determine the importance of soil studies prior to the siting of landfills.

Method
Students will compare the water-holding capacity of various soils.

Materials
Empty milk or juice plastic containers, cups of pebbles, gravel, coarse sand, fine sand, topsoil, clay (any soil samples available), watch or clock with second hand, jars of water, bowls, measuring cup, student worksheets (one per pupil or group).

Subjects
Science, Geology.

Skills
Observing, recording.

Time
40 minutes.

Source
Oscar's Options.

Resources
Solid Waste Districts; State of Vermont Solid Waste Management Rules; State Geologist; geologic survey maps.

AVR Guide Resources

PARALLEL ACTIVITIES
K-3 ● III.A.3 Litter Garden;
4-6 ● II.B.1 Landfills;
7-8 ● II.B.1 Mini Landfills;
9-12 ● II.B.1 New Landfills;
II.B.2 Methane.

INFORMATION
II.B.2 Landfills.

RESOURCES
A.5 Landfills; C.4 General.

BACKGROUND

The nature and composition of subsurface material should be known for a distance of at least 20 feet below the lowest part of the landfill, to bedrock, or to the water table, whichever is shallower...Landfill base soil should be relatively impermeable and have some capability to attenuate or remove contaminants expected in leachate...The development of a landfill in areas underlain by bedrock is not recommended because of the possibility of groundwater contamination through fractures in the bedrock...All other factors contained in these guidelines notwithstanding, it is expected that some unquantifiable amounts of leachate will enter the groundwater within the zone of influence. In particular, the organic fraction of the leachate receives little or no attenuation while passing through even the best base soils. Therefore, the determination of the potential zone of influence and the landfill's possible effect on this area is the most critical portion of the hydrogeologic evaluation of a proposed site.

-- Excerpts from State of Vermont's
Guidelines for the Landfill Disposal of Solid Waste

LEADING QUESTION
Why is it important to test the soils of a potential landfill site?

PROCEDURE

1. To prepare containers, perforate the cap of each plastic jug and cut off the bottom end. Replace the cap, then fill the container about two-thirds full with one kind of soil. Repeat with as many types of soil as desired. In addition, prepare a separate container of soil in which you place several tablespoons of powdered paint into a well in the soil, and cover completely so that students will not know the paint is there.

2. Select one of the soil containers. Pour in one pint of water, noting the time you begin to pour. Place a bowl underneath the container cap to catch the water. Record how much time passes before the water starts dripping into the bowl and the duration of the water dripping. Measure the amount of water that came through and compare with the amount with which you started. Discuss what happened to the remaining water. What conclusions can be drawn?

3. Repeat the experiment with each type of soil. When the experiment is performed with the soil containing the paint, the students should be surprised to see colored water. Discuss with students the fact that, like the paint, there are many hazardous wastes buried in the ground which are not detectable to the eye. Although the land beneath a landfill may look all right, continuous testing must be done to detect hazards before they leach into groundwater supplies.

Vocabulary: groundwater, hazardous waste, leach, percolate, soil, zone of influence, attenuate.

LANDFILL SOIL 7-8 ● II.B.2

EVALUATION

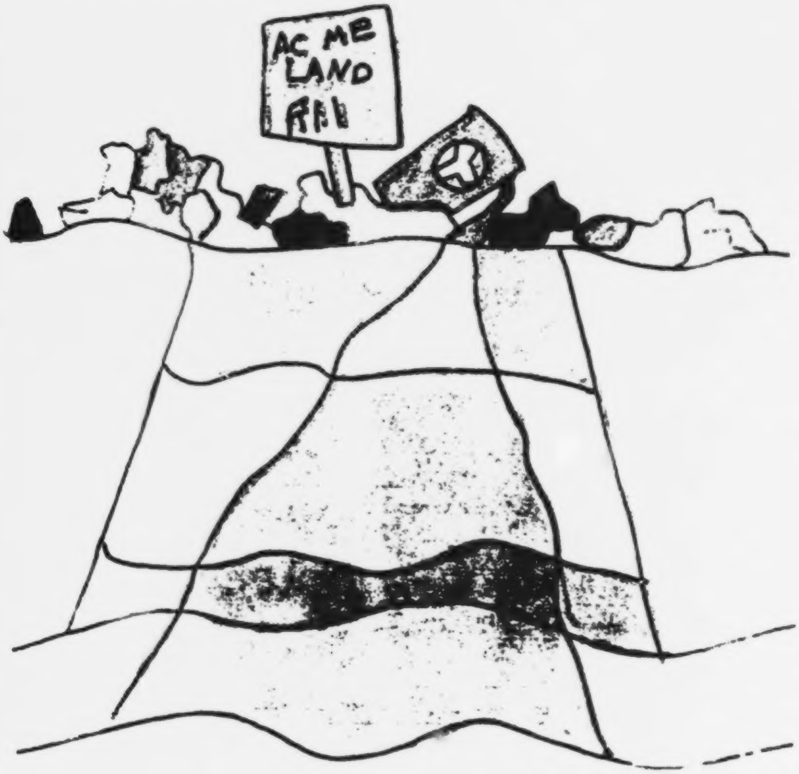
What types of soil would students recommend be the base for landfills? Why?

EXTENSIONS

A. Fill several large cans with soil, each with a different type, (gravel, sand, clay, etc.). Press a sharpened pencil into each can to see how far it can be inserted. Compare and record results. Next, wet the soils and try again. Let the soils dry and record results a third time. Students can make comparisons among the soils and among the three tests, and make judgements on which types of soil were the most or least compact. Compare results with the above experiment.

B. Consider the following problem: There is a swamp about fifteen miles from your town. The land cannot be used for farmland and no one builds homes in a swamp. Would this be a good location for a future Vermont landfill?

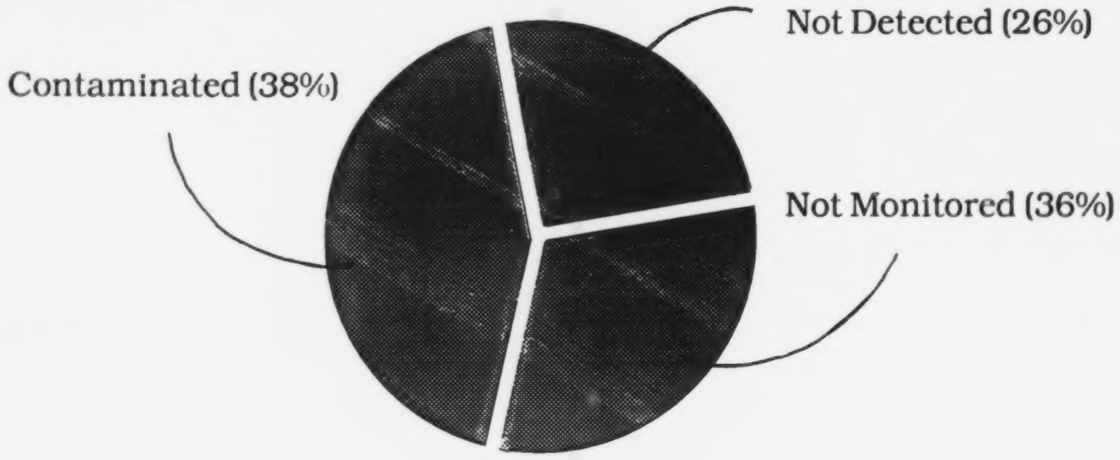
C. Simulate the siting of a new landfill in your community. See 9-12 ● II.B.1 NEW LANDFILLS.



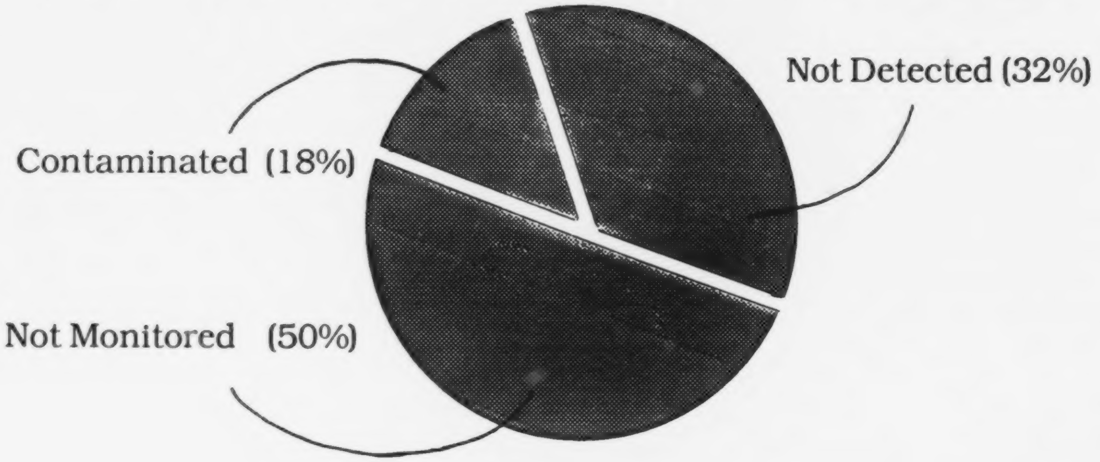
Newark Street School, West Burke

VERMONT LANDFILLS

GROUND WATER IMPACT STATEMENT



SURFACE WATER IMPACT STATEMENT



Source: Vermont Agency of Natural Resources, March 1987

LANDFILL SOIL

Name: **Date:**

SOIL TYPE	TIME ELAPSED BEFORE PERCOLATION BEGINS	TIME ELAPSED UNTIL PERCOLATION IS COMPLETED	AMOUNT OF WATER RELASED FROM SOIL	CONCLUSIONS

BURNING CANS

7-8 ● II.B.3

Concept
Burning can reduce the volume and weight of solid waste, but produces air emissions and ash still needing disposal.

Objective
Students will calculate the reduction in weight and volume of solid waste from burning.

Method
Students will burn various materials.

Materials
One-gallon can with several ventilation holes about one inch from bottom; a piece of metal screen large enough to cover the top of the can; 5 pieces of cardboard, six inches square; masking tape; enough solid waste to fill a box 6" x 6" x 6"; lunch scraps such as orange or banana peels, egg shells, small milk carton, napkins, etc.; matches; ruler; student worksheet (one per student).

Subjects
Math, Science.

Skills
Observing, recording and interpreting data.

Time
One class period.

Sources
Oscar's Options; Workshop.

AVR Guide Resources

PARALLEL ACTIVITIES

4-6 ● II.B.2 Investigating Incineration; 9-12 ● II.C.2 Waste Management Choices.

INFORMATION

II.B 1. Incineration;
II.C Public Planning and Policy.

RESOURCES

A.6 Incinerators;
A.11 Environmental Groups;
B.5 Environmental Groups;
C.7 Incineration; C.8 Plastics and Packaging.

BACKGROUND
This activity illustrates the volume and weight reduction possible through burning waste. It also illustrates that burning produces air emissions, but ***does not simulate the operation of a state-of-the-art incinerator***. While backyard burning cans allow pollutants to escape into the atmosphere, today's incinerators capture 99% of these emissions. Therefore, weight and volume reductions will be more dramatic in this experiment than in an incinerator.

According to Andre Rouleau of the Agency of Natural Resources, HDPE is made only from natural gas and petroleum, burns completely and produces no toxic by-products. *DO NOT BURN* any other types of plastics. It is impossible to tell what types of resins and/or additives are used in the hundreds of different plastic packaging, and many plastics such as PVC, polypropylene, or polystyrene produce toxins when burned.

LEADING QUESTION
Why do we burn trash?

PROCEDURE
1. Distribute student worksheets and explain that in this lesson they will be burning representative waste items to observe the effects of incineration. Tape cardboard pieces together to form a box with four sides and a bottom. Fill the box with the waste, and have students calculate the volume.

Volume of waste = length x width x height.
Volume of waste = 6 in. x 6 in. x 6 in.
Volume of waste = 216 cubic inches.

2. Transfer the waste from the cardboard box to the gallon can. Light the materials on fire and immediately cover the top of the can with the screen. Observe what comes out of the can while the materials are burning. Have students record their observations in the appropriate area on the worksheet for future discussion.

3. When burning is complete and ashes have cooled, return the ashes to the cardboard box. Spread them evenly on the bottom of the box and measure the depth (height) of the ash layer. Using the same formulas above, calculate the volume of the ash. Now, calculate the difference in the volume occupied by the waste before and after burning.

EVALUATION
Why shouldn't we burn trash in our backyards?

EXTENSIONS
A. Research the different toxins produced by burning various objects, and their potential health effects.

B. Research methods of pollution control in incinerators.

C. Visit a waste-to-energy plant.

Vocabulary: volume, ash, pollution, incinerator, landfill.

Name: **Date:**

Calculate the volume of the waste to be burned:

Volume = length x width x height.

Multiply: ____________ x____________ x ______________

Volume of the waste = ________________________________

What is the weight of the waste? ______________________

What comes out of the can while the waste is burning?
Record your observations here:

Calculate the volume of ash:

Volume = length x width x height

Multiply: ____________ x ____________ x ______________

Volume of the ash = ____________________________________

Weight of the ash = ____________________________________

How much has incineration reduced the volume and weight of the waste?

Volume of waste __________ minus volume of ash ___________ equals
_____________ cubic inches or _____________ % of the original waste reduced.

Weight of waste __________ minus weight of ash ___________ equals
____________ (weight measure) or % of the original waste reduced.

PACKAGING DESIGN

7-8 ● III.A.1

Concept
Packaging is useful and necessary for many reasons, but also contributes significantly to our society's solid waste problems.

Objective
Students will explore parameters of packaging design and will use these guidelines in their own design project.

Method
Students will design an environmentally sound packaging.

Materials
Magazines, drawing materials.

Subjects
Art, Social Studies, Home Economics, Industrial Arts.

Skills
Designing.

Time
One or more class periods.

Source
A Way With Waste.

Resources
The Aluminum Association; Arthur Purcell, "The World's Trashiest People," *The Futurist*; Martin Pawley, *Building For Tomorrow.*

AVR Guide Resources

PARALLEL ACTIVITIES

K-3 ● I.A.3 Too Much Packaging;
K-3 ● III.A.1 Egg Cartons;
4-6 ● I.A.3 The Story of...;
4-6 ● III.A.1 Pondering Packaging;
9-12 ● I.A.2 Packaging Preferences;
9-12 ● III.A.2 Cart Before the Horse.

INFORMATION

I.A.7 Packaging;
II.C Public Planning and Policy;
III.A Redesign and Reuse.

RESOURCES

B.4 Industry Associations;
C.8 Plastics and Packaging.

BACKGROUND

FUNCTIONS AND BENEFITS OF PACKAGING:

- Preservation and protection of contents
- Sanitation and safety, protection of public health
- Identification of product
- Prevention of theft
- Providing instruction as to product use
- Compliance with regulatory standards
- Manufacturing of packaging provides employment
- Increase sales and profits by making the product attractive
- May decrease cost of product to consumer

DRAWBACKS OF PACKAGING:

- Contributes significantly to solid waste
- Without reuse or recycling, wastes the energy and natural resources that go into packaging
- Contributes significantly to litter
- May create false impressions about the amount or quality of products
- May increase the cost of a product to the consumer

LEADING QUESTION

How could packaging be designed to waste less?

PROCEDURE

1. Have students look through magazines for about ten minutes and cut out pictures of packaged products.

2. Have students choose one of the products for which they would like to design an alternative packaging.

3. Ask the students to look at their product and decide what the designer was trying to accomplish. Discuss the functions and drawbacks of packaging. Are any of the products designed to protect the environment?

4. Have the students design a new environmentally-sound alternative to their packaging. The designs should include considerations of waste reduction, reuse, and recycling as well as public safety, product protection, shipping weight, cost of packaging material, advertising, and public demand. New design parameters should include some or all of the following: minimum resource extraction, minimum use of energy in processing, minimum transportation, selection of reusable or recyclable resources, design for reusability and recyclability, use of non-hazardous materials, etc. How do these new parameters conflict with or limit the old ones?

5. Have the students make drawings of prototypes, present them to the class and explain how their design decisions were made.

Vocabulary: design, parameters, packaging, prototypes.

PACKAGING DESIGN

7-8 ● III.A.1

EXTENSIONS

A. Make models of new package.

B. Have students write to and send their designs/prototypes to packaging manufacturers as suggestions for improvement in packaging design.

C. Analyze a variety of products, measuring the actual amount of the product compared to the size and shape of the product's package.

D. Invite representatives from the grocery business and the packaging industry to class to discuss packaging. Invite an industrial designer to class to discuss packaging design.

E. Research the regulatory standards packagers and retail outlets are required to meet. Who sets these standards? Why are they required? Why is safety a concern today?

F. Discuss the pros and cons of new types of packaging. (brickpacks, plastic cans).

G. Have students complete the attached "How Do You Stack Up?" worksheet.

HOW DO YOU STACK UP?

The things you do or don't do every day can make a difference in the amount of garbage you produce! Here's your chance to stop and consider just what your contribution is. Take a few minutes to complete this checklist. Then find your total by adding the numbers you circled in each column. The back of this sheet will tell you how you stack up.

DO YOU...	NEVER	SOME-TIMES	OFTEN
● take advantage of opportunities to recycle in your area?	3	2	1
● shop at garage sales and second-hand stores?	3	2	1
● try not to use disposable products when longer-lasting alternatives are available?	3	2	1
● use sponges and dishcloths rather than items that can be used only once?	3	2	1
● compost yard debris, kitchen waste, and other organic matter?	3	2	1
● think about what happens to a product or package when you're finished with it?	3	2	1
● try to reuse things instead of disposing of them and buying new ones?	3	2	1
● consider whether you really need something before you buy it?	3	2	1
● consider whether pollution and wastes were caused by manufacturing the item you buy?	3	2	1
● avoid products with "built-in obsolescence?"	3	2	1
● express concern about the need to produce less wasteful products by writing product manufacturers or your legislator?	3	2	1
● ask that the least amount of paper and plastic wrapping be used for your order in fast-food restaurants?	3	2	1
● talk to store managers about stocking products in bulk or avoiding unnecessary packaging?	3	2	1
● spend money to repair an item even though you could get a new one for nearly the same price?	3	2	1
● make a habit of reading labels and consumer information articles to learn about the quality and durability of products you buy?	3	2	1

☐ + ☐ + ☐ =

grand total __________

GRAND TOTAL ____________

IF YOUR SCORE WAS

40 or more

You're contributing a great deal of trash to our rapidly-filling landfills, including thousands of tons of reusable, recoverable materials which are thrown away each year!

what you can *do!*

- Become more aware of the amount of trash you throw out every day. What could be reused, recycled, or avoided completely?
- Next time you go to the store, see if products you usually buy in nonrecyclable containers are also available in returnable, refillable, or recyclable containers.
- Call your local government, garbage collector, or recycler for information on how, when, and where to recycle.

between 21 & 39

Pretty good! It's obvious you're doing some reusing, recycling, and reducing the amount of trash you throw out. These habits need to be practiced consistently by every Vermonter if we're to reduce the ever-increasing quantity of waste produced in our state.

what you can *do!*

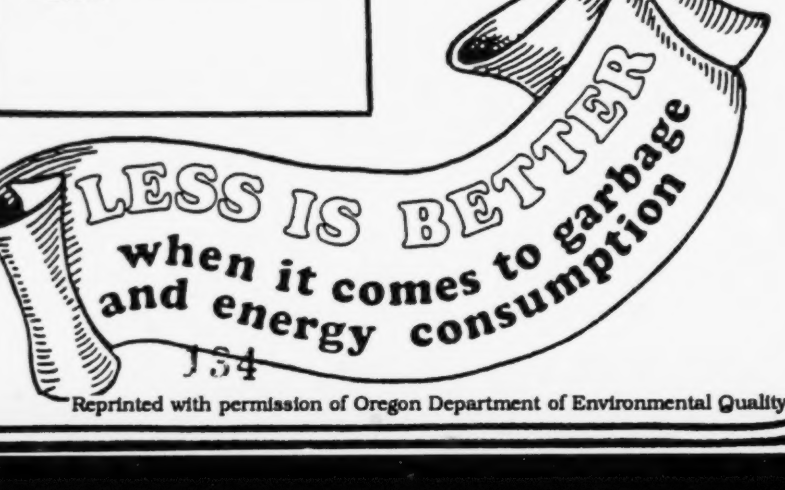
- Look at various types of packaging and the available alternatives. Does it cost you more or less to buy reusable or recyclable packages?
- Reuse plastic sacks; bring your own grocery bags to the supermarket.
- Look around your home for more items to recycle and phone your local government, garbage collector, or recycler for information.

20 or less

Congratulations! Obviously you've done some serious thinking about the need for waste reduction and recycling. You're helping ensure that future generations will enjoy Vermont's natural resources, pristine beauty, and famous "quality of life." You're also providing jobs for the many people working in industries that use recycled materials to make new products.

what you can *do!*

- Encourage one other person to recycle. You set a good example!
- Write letters, attend meetings. Get involved in solid waste management in your community.
- Give yourself a pat on the back and keep up the good work!


LESS IS BETTER
when it comes to garbage and energy consumption

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SOURCE SEPARATING 7-8 ● III.B.1

Concept
The most efficient method for sorting recyclables is to separate them at their source.

Objective
Students will design containers for the easy and efficient source separation of recyclables.

Method
Students will design (and build) containers for recycling.

Materials
Attached handouts, additional information and designs, shop equipment and materials, drawing and graphing materials.

Subjects
Industrial Arts, Home Economics, Social Studies, Art.

Skills
Drawing, measuring, designing, analyzing, problem solving.

Time
Two class periods for discussion, design and drawing.

Sources
Ohio Educator's Guide - Looking Good In Ohio; Cynthia Pollack, "Mining Urban Wastes: The Potential for Recycling" (*Worldwatch Paper 76*, 1987).

Resources
Peter Anderson, Marion Cross School; *Rodale's New Shelter Magazine* (February 1982); *Resource Recycling Magazine*.

AVR Guide Resources

PARALLEL ACTIVITIES

K-3 ● III.B.2 What's Recyclable?;
4-6 ● III.B.3 Where to Recycle;
9-12●III.B.2 Collecting and Sortng.

INFORMATION

II.A. Transportation and Processing; II.C Public Planning and Policy; III.A Redesign and Reuse; III.B Recycling.

RESOURCES

A.7 Places to Recycle; A.9 Recycling Business; C.5 Recycling.

BACKGROUND

Paper rapidly loses its value when mixed with other refuse, particularly organic food waste. Glass and metals, while less vulnerable to degradation, compete with uncontaminated raw materials in the marketplace. Organic wastes destined for the compost pile are easiest to handle if they are free of inorganics and substances toxic to plants. As a rule, the nearer to the origin of the waste that recovery occurs, the less sorting and processing will be needed before the materials can be recycled. The cleanest secondary materials always command the highest prices. --Cynthia Pollack, 1987.

LEADING QUESTION

What is the best way to sort and store our recyclables?

PROCEDURE

1. Discuss the benefits of source separation in recycling. Review the different types of sorting containers illustrated and the different purpose each serves.

2. Ask where recycling centers might be needed in the home, community or school? Have students list.

3. Ask what different design features need to be considered for each location? Have students consider the following for each location:

   - What type of space is the container to serve? (school, classroom, park, kitchen, garage, office, etc.)?
   - Are there any space limitations?
   - What is the projected volume, weight and type of recyclable the container will need to hold?
   - How often will it need to be emptied?
   - How will the contents (and/or the container itself) be transported and emptied?
   - Will the container need to be cleaned frequently?

4. Break into groups of students each taking a different location. Each group should design a container to meet the outlined needs of their location. Students make a drawing of the container and present it to the class, explaining why it meets the needs.

EVALUATION

Students present their designs. Is the container convenient, clean and functional?

EXTENSIONS

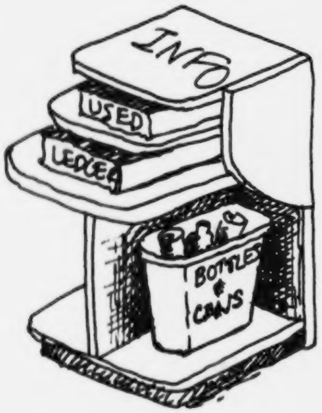
A. Develop a project requirement list including materials to be used, equipment needed, skills necessary, specifications for container, and build a prototype. If possible, use salvaged materials. Test its usefulness by sorting and storing recyclables, and modify the design if needed.
B. Design a recycling center for the community or school. See 9-12 ● III.B.2 COLLECTING AND SORTING.
C. Visit and compare existing source separation sites.
D. Design a truck for the collection of recyclables.

Vocabulary: source separation, container.

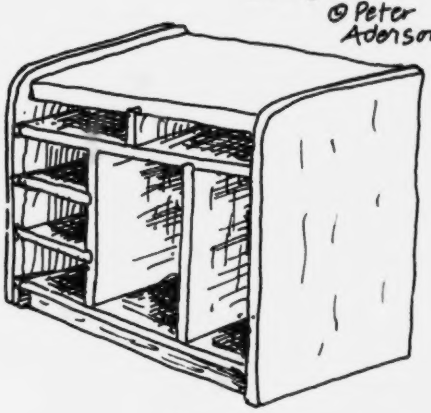
SOURCE SEPARATION CONTAINERS

for parks & public places

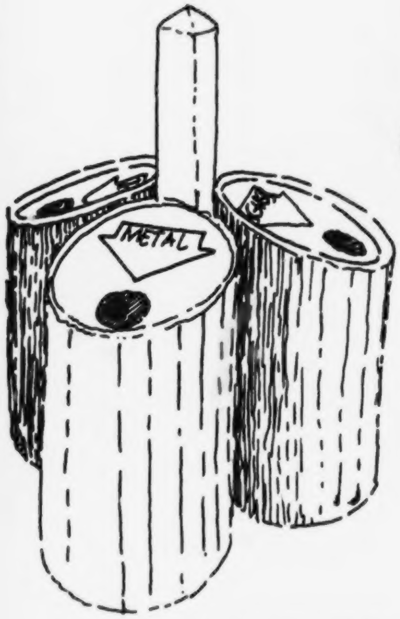
Recycling Bells



Sort Centers ©Peter Aderson



for classroom use



Windsor Barrel Works

↓ FOR THE HOME ↓

Kitchen Compost

GRAPHING RECYCLABLES

7-8 ● III.B.2

Concept
Continuing and comparative studies may be done to find the most profitable place to take recyclables.

Objective
Students will see how fluctuating markets and different offered prices affect the fate of recycling.

Method
Students will graph prices offered for recyclables.

Materials
Graph paper, transparencies, list of recycling businesses.

Subjects
Math, Business.

Skills
Recording and interpreting data, graphing.

Time
Several months.

Source
A Way With Waste..

Resources
Local Recycling Businesses, *Resource Recycling Magazine* (Market Update Section); William D. Robinson, *The Solid Waste Hankbook;* ANT, Recycling Markets Directory.

AVR Guide Resources

PARALLEL ACTIVITIES

4-6 ● III.B.3 Where to Recycle;
9-12 ● III.A.2 Cart Before the Horse.

INFORMATION

III.A Redesign and Reuse;
III.B Recycling.

RESOURCES

A.7 Places to Recycle;
A.9 Recycling Businesses;
B.4 Industry Associations;
C.5 Recycling.

BACKGROUND

Vermont faces a different set of challenges than its southern neighbors with respect to recycling. The rural character of Vermont means potentially recyclable materials are more scattered than in more urban states. This contributes to the per-ton collection and transport costs. Vermont's relatively small quantity of potentially available material also increases per-ton processing costs . Finally, most traditional markets for recycled materials are located out-of-state, which increases transport costs, reducing the value of the materials generated in Vermont. [As more materials are recycled in New England, an] increase in supply [of recyclables] could stimulate additional demand, or especially in the short term, could swamp existing markets. Vermont is especially vulnerable because we generate relatively small quantities that are far from markets.

-- State of Vermont, Solid Waste Management Plan (1988).

LEADING QUESTION

Do Vermont recycling businesses pay us for the materials we collect?

PROCEDURE

1. List materials which are recycled in your area. Then list materials which are technically possible to recycle, but not recycled in your area. Is there a difference in the lists? If so, why?

2. Look at the list of recycling businesses serving Vermont. Call several recyclers. Ask them what price they are receiving for each ton of material they deliver to market. Ask them what factors influence the price they are paid for recyclables. List. Do they pay citizens for recyclables collected?

3. Graph the information by both (a) and (b):
a) Type of material

- *glass* (green, brown, clear or mixed),
- *paper* (newsprint, corrugated cardboard, white ledger or mixed),
- *metals* (steel cans, bimetal cans, aluminum cans, other metals).
- *plastics* (HDPE, PET, others)

b) Prices being offered by recyclers.

4. Study price changes on a monthly basis.

5. Using the graphed information, which recyclers pay the most? If the prices are the same, discuss why this is so. Why might the price vary from month to month?

EVALUATION

Do some recyclers pay more than others for material? Do prices change from month to month? What factors might influence prices paid for recyclables? (Some recyclers may include transportation, storage containers, etc. in the price offered.)

EXTENSIONS

A. Compare transportation costs with the value of the materials being recycled.

B. Discuss the questions on the following worksheet.

Vocabulary: subsidize, recyclable.

Name: **Date:**

The Business of Recycling

a. Why is the recycling center located where it is?

b. If there is not a recycling center in your town, where would be the best place for one?

c. How might location affect the price recycling center operators pay and/or receive for their recyclables?

d. What kinds of equipment are used at the recycling center? Who pays for their costs?

e. What kinds of transportation might be used to deliver recyclables to a manufacturer?

f. How might the cost of transportation of any one recyclable affect the profit of the recycling center operator.

g. What might affect the price a manufacturer pays a recycling center for its recyclable material?

h. Should resources be recycled at a financial loss? If so, who should subsidize the recycling center operators so they will do it?

i. Can you think of any subsidies that government provides the wood and plastics industries that make it difficult for recyclable materials to compete?

DESTINATION RECYCLE

7-8 ● III.B.3

Concept
Successful recycling depends in part on the availability of convenient recycling opportunities as well as dependable markets and market demand.

Objectives
Students will identify the destination and fate of Vermont recyclables.

Method
Students will produce maps of Vermont and U.S. recycling markets.

Materials
County, state, New England or U.S. maps; list of places to recycle, Resource Section A.7; recycling businesses, Resource Section A.9; list of end-users of recyclables; mapmaking tools.

Subjects
Social Studies, Business.

Skills
Mapmaking, researching.

Time
Once class or overnight assignment.

Sources
A Way With Waste; Agency of Natural Resources.

Resources
Local recycling businesses; ANR and Solid Waste Districts for current lists; Cynthia Pollack, *Worldwatch Paper 76*.

AVR Guide Resources

PARALLEL ACTIVITIES
4-6 ● III.B.3 Where to Recycle;
7-8 ● III.B.2 Graphing Recyclables.

INFORMATION
I.A.5 Components of the Waste Stream;
III.B Recycling.

RESOURCES
A.7 Places to Recycle;
A.9 Recycling Businesses;
B.4 Industry Associations;
C.5 Recycling.

BACKGROUND

Most of Vermont's recyclables are currently sent out of state for processing and end-use. General market locations are as follows:

Deposit plastic soda bottles are shipped to South Carolina, where the clear plastic is converted to polyester fiberfill. Base cups are reground and used to make new base cups or construction pallets. The green bottles can be made into polyester fiber-fill as well. When necessary, the bottles are land banked for future use.

Aluminum beverage cans are shipped to aluminum smelters in Texas, Pennsylvania, and points south. Aluminum scrap is used to make secondary aluminum scrap, billets, extrusions, and lead and aluminum alloys and new beverage cans.

Newsprint is usually used to make new newsprint or cellulose insulation. Markets are located within 200 miles of Vermont; one cellulose insulation plant is located in Hardwick, Vermont. Corrugated and Mixed Paper are also shipped within 200 miles of Vermont. Corrugated is used to make lower grade cardboard for cardboard box liners.

LEADING QUESTION
When you recycle, where does it all go?

PROCEDURE
1. Break students into groups and assign a different recyclable (plastics, glass, newsprint, paper, aluminum, tin cans, batteries, waste oil) to each group.

2. Have each group research their material, answering some or all of the following questions, and report their findings to the class.

3. Discuss the difficulties of recycling, their causes, and some possible solutions.

EVALUATION
What problems do we need to solve if recycling will work?

EXTENSION
A. Trace the global exchange of recyclables and raw resources.

B. Investigate the garbage barge phenomenon. Is landfill space becoming an international commodity?

Vocabulary: cellulose insulation, end-use.

Name: **Date:**

When You Recycle Where Does It All Go?

a) Where is the closest recycling center which accepts your material?

b) What is the nearest commercial recycling business?

c) What businesses within the state use your material in manufacturing?

d) Where are the other end-users of the material? in New England, the east coast, the U.S., abroad?

e) What is the average distance required to send recyclables to market?

f) What are the transportation costs involved in shipping the material to its end-user?

g) What are the prices offered for the material?

h) What is the recyclable used to make?

i) Compare the costs of recycling to the costs of extracting, shipping and processing raw material.

HOW CAN WE RECYCLE ORGANIC WASTES?

MAKING GOOD COMPOST

7-8. ● III.C.1

Concept

Recycling by composting improves soil structure and fertility and reduces the volume of household solid waste requiring disposal.

Objective

Students will conduct experiments testing the effects of too little water, nutrients, air, and imbalance of material on producing successful compost, and will learn the basic principles necessary to construct a good compost pile.

Method

Class will construct six different compost situations and compare results.

Materials

Organic waste (manure), soil, five five-gallon buckets, thermometer.

Subjects

Biology, Horticulture, Vocational Agriculture.

Skills

Experimenting, recording and analyzing data, predicting.

Time

A few weeks.

Source

A Way With Waste.

Resources

METRO, *The Art of Composting*; Stu Campbell, *Let It Rot*; Rodale Press, *The Complete Book of Compost*.

AVR Guide Resources

PARALLEL ACTIVITIES

K-3 ● III.C.1 Banana Peel Blues;
4-6 ● III.C.1 Mini Compost;
9-12 ● III.C.1 Micro-Organisms;
9-12 ● III.C.2 Effective Fertilizers.

INFORMATION

III.C Compost.

RESOURCES

C.6 Composting.

BACKGROUND

In a residential waste stream study performed in 1986, Association of Vermont Recyclers volunteers identified almost 32% of an 800-pound sampling of trash as compostable. In a trash analysis at U-32 High School in East Montpelier, Brian Slopey and his class determined the food category (including any safely biodegradable or compostable material such as natural cloth, wood, and dirt) to outweigh any other category of trash. Brian's students calculated that up to 93% of U-32's trash could be recyclable.

LEADING QUESTION

What are the essential ingredients for a successful compost?

PROCEDURE

NOTE: This activity should be begun in early Fall or Spring for best results.

1. Read about composting and the alternatives for construction of compost bins or containers. Choose the methods within your time and budget limitations. Try to keep compost piles about one cubic yard, or if necessary, use five five-gallon buckets with holes drilled in the sides.

2. Start six compost piles, each unique in one of the ways listed on the worksheet. (Use grass clippings, leaves, manure, weeds, hay, sawdust, household organic wastes (excluding bones, meat, grease or animal products that will cause odors or attract pests).

3. Have each group record the daily temperature of its pile and other observations for a few weeks.

4. Discuss the results. Which experimental compost was most successful? How is composting related to the concept of recycling? What are the consequences of not recycling vital chemicals to their origins? How can composting reduce waste? Where does composting occur naturally?

EVALUATION

Why did one pile break down wastes faster than others? What are the essential ingredients of a good compost system?

EXTENSIONS

A. Discuss how the compost pile is an example of the nitrogen cycle and other natural cycles in our biosphere.

B. Test the effects of different soils on plant growth.

Vocabulary: composting, nitrogen, cycles.

MAKING GOOD COMPOST

7-8. ● III.C.1

Name: **Date:**

1. Low In Nitrogen
    a. NO ORGANIC WASTE THAT IS HIGH IN NITROGEN
    b. keep moist, don't soak with water
    c. turn regularly, every three or four days at first, then once a week.
    d. include a mixture of ingredients: garbage, clippings, leaves, weeds, etc.
    e. critters

2. Not Enough Moisture
    a. include manure and contents which are high in nitrogen
    b. turn regularly
    c. have a good mixture of ingredients
    d. DO NOT WATER, don't add moist garbage
    e. critters

3. No Air Circulation
    a. include material high in nitrogen
    b. keep moist
    c. DO NOT TURN
    d. balanced mixture of ingredients
    e. critters

4. Too Much Of A Single Ingredient
    a. include nitrogen material
    b. keep moist
    c. turn regularly
    d. USE ALL BONE MEAL OR MANURE
    e. critters

5. No Little Critters
    a. use potting soil (sterilized)
    b. turn regularly
    c. keep moist
    d. good mix of ingredients
    e. include material rich in nitrogen
    f. NO CRITTERS

6. Good Compost Pile
    a. include nitrogenous material (manure and blood meal are good sources)
    b. keep moist
    c. turn regularly
    d. include a good mix of ingredients which are layered.
    e. critters, (earthworms should be added after temp. drops)

9-12 ACTIVITIES CONTENTS

I. *WHAT IS WASTE?*

- **A. THE SOLID WASTE STREAM**
  - 1. SOURCES OF WASTE
  - 2. PACKAGING PREFERENCES
- **B. NATURAL RESOURCES AND WASTE**
  - 1. NONRENEWABLE RESOURCES
- **C. WASTE AND SOCIETY**
  - 1. SHOPPER SURVEY
  - 2. GARBAGE
  - 3. THE DUMP GROUND
  - 4. GNPP: GREAT NEW PURCHASING POWER

II. *HOW DO WE MANAGE WASTE?*

- **A. SOLID WASTE HANDLING AND LITTER**
- **B. TREATING AND DISPOSING WASTE**
  - 1. NEW LANDFILLS
  - 2. METHANE
  - 3. SPREADING SLUDGE
  - 4. TOXIC WASTE IN THE LAB
- **C. DECIDING WHERE WASTE GOES**
  - 1. COMMUNITY SOLID WASTE
  - 2. WASTE MANAGEMENT CHOICES

III. *HOW CAN WE REDUCE WASTE?*

- **A. CHANGING HABITS AND DESIGNS**
  - 1. 20 FOOT SWATH
  - 2. CART BEFORE THE HORSE
- **B. RECYCLING**
  - 1. RECYCLING PAPER POLLUTION
  - 2. COLLECTING AND SORTING
  - 3. SPEAKING FOR RECYCLING
- **C. COMPOSTING**
  - 1. MICROORGANISMS
  - 2. EFFECTIVE FERTILIZERS

WHERE DOES WASTE COME FROM?

SOURCES OF WASTE 9-12 ● I.A.1

Concepts
All human activities produce waste. There are many different sources of waste in society.

Objective
Students will research different sources of waste in society and will trace the production of waste in industry.

Method
Students will research local business and industry.

Materials
Handout.

Subjects
Social Studies, Science.

Skills
Researching.

Time
Several days.

Source
State of Vermont *Solid Waste Plan.*

Resources
Local industries; Agency of Development and Community Affairs.

AVR Guide Resources
PARALLEL ACTIVITIES

K-3 ● I.B.1 Machine;

4-6 ● I.B.1 What Kind of Waste Am I?;

7-8 ● I.A.2 School Trash Analysis.

INFORMATION

I.A The Solid Waste Stream.

RESOURCES

A.10 Vermont Businesses;

B.4 Industry Associations.

BACKGROUND
About 60% (345,900) of Vermont's 535,000 residents live in rural areas. There are 189,100 urban residents living in eight major cities and an additional seven towns with a population of 5,000 or more. Vermonters work in the tourism industry, manufacturing of electronic products, printing and publishing, engage in wholesale and retail trade of apparel and food and drink, bank sell insurance and real estate, and provide lodging, food, educational, hospital and nursing care, and other services within the state. Environmental management activities in the state include 127 wastewater treatment plants, 154 public water treatment plants, 11 hospital incinerators, and 4 municipal incinerators/energy plants. Each of Vermont's residents and all of these different activities produce waste.

LEADING QUESTION
How do we determine the amount of waste we produce?

PROCEDURE
1. Review the attached flowchart with the class.

2. Have each student research one of Vermont's products such as cheese, maple syrup, furniture, printed material, etc. Contact manufacturing plants to find out how much and what types of waste they produce. What recycling and design strategies do they employ to fight waste? What are their waste disposal costs? Have they changed recently? How?

EVALUATION
Students illustrate their findings in their own flow chart which tracks and identifies all the sources of waste in the item's production, use and disposal.

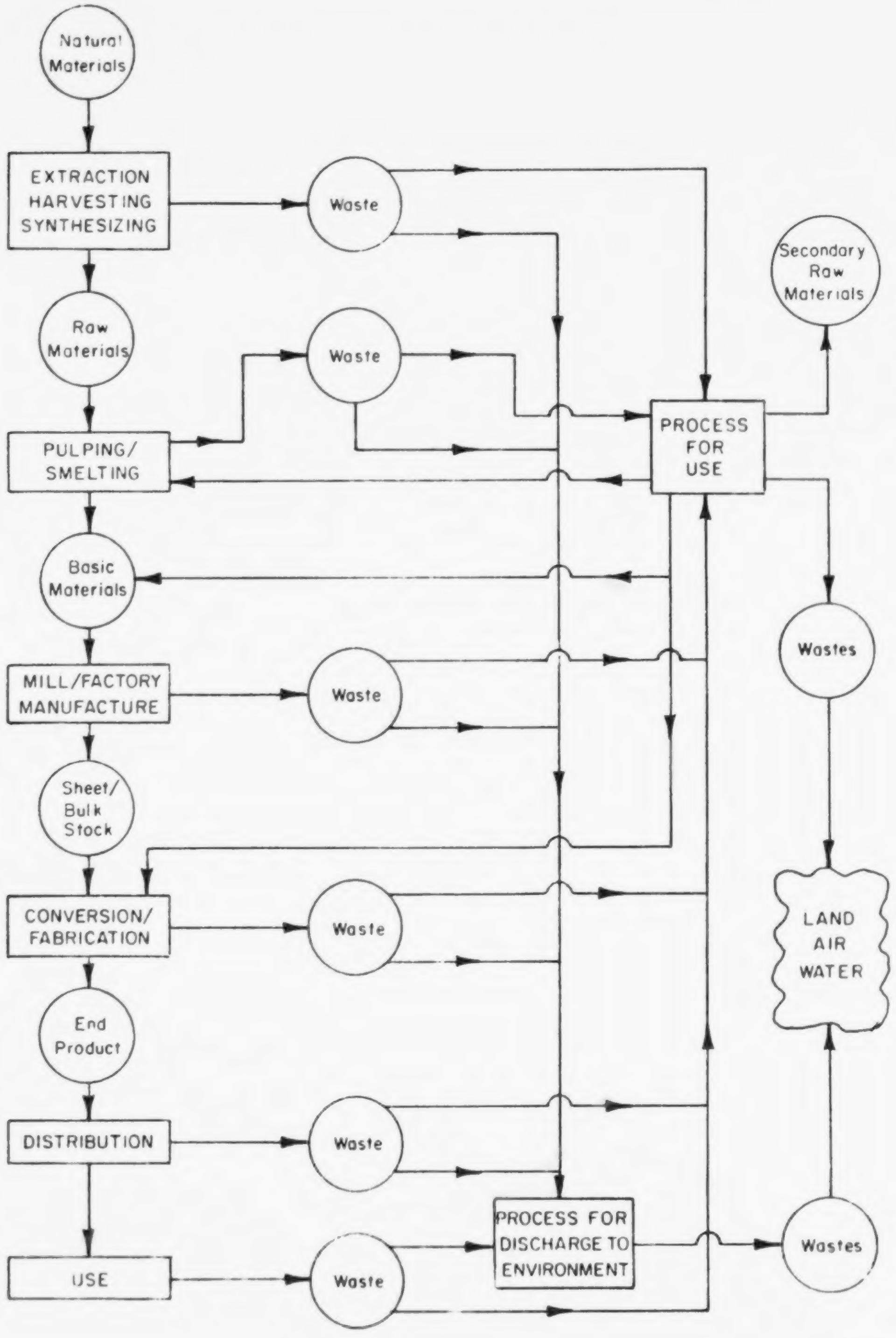
EXTENSIONS
A. Design a waste reduction and/or recycling strategy for a local business or industry.

B. Design a new product out of the waste from a local business.

C. Record types and amounts of home waste on a daily basis. Make estimates of yearly totals.

Vocabulary: preconsumer waste, manufacturing waste.

SOURCES OF WASTES IN A SOCIETY



SOURCE: State of Vermont Solid Waste Plan

HOW DOES PACKAGING CONTRIBUTE TO WASTE?

PACKAGING PREFERENCES

9-12 ● 1.A.2

Concept
Some types of packaging are better for the environment than others.

Objective
Students will evaluate the environmental impact of different packaging types.

Method
Students will graph environmental costs of different containers.

Material
Attached worksheets.

Subjects
Math, Science, Social Studies.

Skills
Graphing, inferring.

Time
One class period.

Sources
Oscar's Options; The Great Garbage Machine. John Seymour and Herbert Girardet, *Blueprint for A Green Planet.*

Resources
George Pess, *Thermoplastics in The Postconsumer Waste Stream;* articles on plastics; Tom Hill, Plastics Are Forever" *Upper Valley* (Jan/Feb 1989).

AVR Guide Resources

PARALLEL ACTIVITIES
K-3 ● III.A.1 Egg Cartons;
4-6 ● I.A.3 The Story Of...;
7-8 ● I.A.3 Potato Cakes.

INFORMATION
A.7 Packaging.

RESOURCES
B.4 Industry Associations;
C.8 Plastics and Packaging.

BACKGROUND
Plastics currently comprise about eight percent of our solid waste stream, a figure that is steadily increasing. Plastics are not biodegradable or easily recycled, they are made from nonrenewable fossil fuels, and some plastic produce toxins when burned. There are hundreds of different types of plastics in use today. Once they enter the waste stream, they are often contaminated with food and other substances, and are practically impossible to identify and separate for recycling. PET soda bottles and milk and cider jugs as well as detergent and waste oil containers are beginning to find markets for recycling because they are made from one kind of plastic and are easily identifiable. But recycling for other plastic films, food container, lids, wraps and tapes is still not easy. Most plastics are made primarily from hydrogen and carbon elements extracted from natural gas and crude oil.

Biodegradable plastic are made by fermentation of natural substances such as sugar and other carbohydrates. One firm has produced biodegradable plastic with the help of a vigorous strain of bacteria found in canals. The bacteria are cultivated in vats and fed a sugary diet on which they thrive. In doing so they multiply and produce biological "plastic" rather like mammals make fat in their bodies as they grow. The plastic is extracted in fermentation vessels, and is then dried and sold as granules. This plastic is readily broken down by algae, fungi, or bacteria in the soil. A bag made from it will disappear within twelve or fifteen months or indeed within only three or four months if it is placed in a compost heap.

--John Seymour and Herbert Girardet, 1987.

LEADING QUESTION
How have beverage containers changed over the years?

PROCEDURE
Distribute "The Choice Is Clear" worksheet and have student graph the information.

EVALUATION
What kind of containers are best for the environment?

EXTENSIONS
A. Have student do "The Restaurant Garbage Counter" worksheet as a homework assignment. Compare results from different restaurants. How can we encourage less packaging waste?

B. Send a letter to the restaurant with class suggestions for waste reduction and recycling.

C. Obtain biodegradable plastic bags and set up a lab comparing decomposition time with regular plastic. These is a year long project which could be done in a compost pile. Examine the effects of sun, temperature, humidity, etc.

Vocabulary: thermoplastic, thermosetting, biodegradable, polymer, photodegradable.

THE CHOICE IS CLEAR

Your parents and grandparents may well remember when milk and soda came in glass bottles. The empty bottles were returned to the store. When the store collected enough bottles, they were trucked back to the bottling company. Sterilization guaranteed there would be no germs left on the bottles. Then each bottle was refilled and sent back to the store. Some bottles made this trip as many as 20 times. When the bottle broke or became too badly scratched, the glass was melted down and reformed.

In the 1970's things began to change. Milk started appearing on grocery store shelved in wax cartons and plastic jugs. The soda industry switched to plastic containers. Businesses made this choice based on cost. They found it cheaper to make millions of plastic bottles than to reuse glass one. Perhaps, for the manufacturer, it does cost less. But what about us? We pay for this through energy and water consumed. Air pollution and increased solid wastes are also part of our cost.

STUDY THE CHART BELOW.
USE THE INFORMATION TO CREATE SIX BAR GRAPHS.

CONTAINER COSTS FOR 1000 GALLONS OF SODA

	GLASS	GLASS	ALUMINUM	PLASTIC	STEEL
Times used	19x	1x	1x	1x	1x
Energy (10 BTU)	15.90	64.38	75.61	63.33	38.33
Water (1000 gal)	11.35	38.94	15.17	41.71	39.01
Industrial Solid Waste (cu. ft.)	6.59	38.46	36.13	7.21	108.00
Atmospheric Emissions (lbs.)	70.52	261.01	323.02	240.07	145.08
Waterborne Wastes (lbs).	27.43	56.46	69.00	68.79	18.14
Post Consumer Solid Waste (cu. ft.)	7.16	40.97	2.07	27.05	3.49

Reprinted from *Oscar's Options*, Rhode Island Department of Environmental Management.

PACKAGING PREFERENCES **9-12 ● I.A.2**

Name: **Date:**

The restaurant garbage counter

There certainly are a lot of quick food restaurants around. The food is served quickly and you don't have to do any dishes. All you have to do is pay the bill. You really pay twice. One price is the money you pay at the cash register. The other cost is harder to calculate. It is an *environmental cost*. Quick food restaurants produce a lot of waste material. It has to be disposed of. You should understand the problem. You should know about the wastes that *you* cause in these restaurants.

Here's what to do:

1 Write down each thing you receive when your order is filled.

2 Identify each item as either food or non-food.

3 For each non-food item, identify the material of which it is made.

4 State whether the material comes from a renewable or a non-renewable resource.

5 Think about the waste that you produce.

A sample is done for you.

ITEM	FOOD	NON FOOD		
		made of	renewable	non-renewable
PAPER BAG		PAPER	X	
BOX		PAPER	X	
PAPER NAPKIN		PAPER	X	
PLASTIC FORK		PETROLEUM		X
PLASTIC KNIFE		PETROLEUM		X
3 CHICKEN PIECES	X			
1 PAPER CONTAINER (SALT)		PAPER	X	
SALT	X			
1 PLASTIC CONTAINER (VINEGAR)		PETROLEUM		X
VINEGAR	X			
FRENCH FRIES	X			
1 PLASTIC GLASS		PETROLEUM		X
1 PLASTIC LID FOR GLASS		PETROLEUM		X
PAPER WRAPPING (STRAW)		PAPER	X	
SOFT DRINK	X			
STRAW (PLASTIC)		PETROLEUM		X
FOIL CONTAINER (TART)		ALUMINUM		X
TART	X			

Reprinted from: *The Great Garbage Machine*, Waste Management Advisory Board, Toronto, Ontario.

Name: **Date:**

The restaurant garbage counter

Restaurant name

ITEM	FOOD	NON FOOD		
		made of	renewable	non-renewable

Reprinted from: *The Great Garbage Machine*, Waste Management Advisory Board, Toronto, Ontario.

NONRENEWABLE RESOURCES

9-12 ● I.B.1

Concept
Natural resources are limited.

Objective
Students will compare estimated life expectancies of some nonrenewable natural resources and will understand the role recycling and careful use play in meeting the demand for the extending availability of these resources.

Method
Students will complete worksheets and discuss.

Material
Attached charts and worksheets.

Subjects
Environmental Science, Social Studies.

Skills
Interpreting data.

Time
One class period.

Source
A Way With Waste.

Resources
Donella and Dennis Meadows. *Limits to Growth;* Cynthia Pollack, *Mining Urban Wastes: The Potential For Recycling. Worldwatch Paper 76;* The World Resources Institute, et al, *World Resources 1988-89.*

AVR Guide Resources

PARALLEL ACTIVITIES

K-3 ● I.B.1 Machine; 4-6 ● I.B.1 What Kind of Waste Am I?; 7-8 ● I.A.2 School Trash Analysis.

INFORMATION

I.A The Solid Waste Stream.

RESOURCES

A.10 Vermont Businesses;
B.4 Industry Associations;
C.4 General.

BACKGROUND

"The global demand for and consumption of most major nonfuel mineral commodities is projected to increase three to five percent annually, slightly more than doubling by 2000." There is a limit to how long an increasing population can continue to make increasing demands on our finite resources. Concentrated, easily mined reserves of nonrenewable resources are being depleted. The availability of these resources can be extended by careful use and recycling.

LEADING QUESTION

How long will our natural resources last?

PROCEDURE

1. Distribute copies of the chart "Selected Nonrenewable Natural Resources: Their Life Expectancies and Prime Consumers." Have students complete the worksheet and/or discuss the questions in class.

2. Discuss "Alternate Depletion Patterns For A Nonrenewable Resource." How can we determine how long a given resource might last? Any projections are based on two major set of assumptions: We must estimate the potentially available supply at existing (or future) acceptable prices and with existing (or improved) technology, and we must estimate the annual rate at which the resource may be used.

Vocabulary: nonrenewable resources, static use, life expectancy, reserve base.

Selected Nonrenewable Natural Resources: Life Expectancies & Prime Consumers

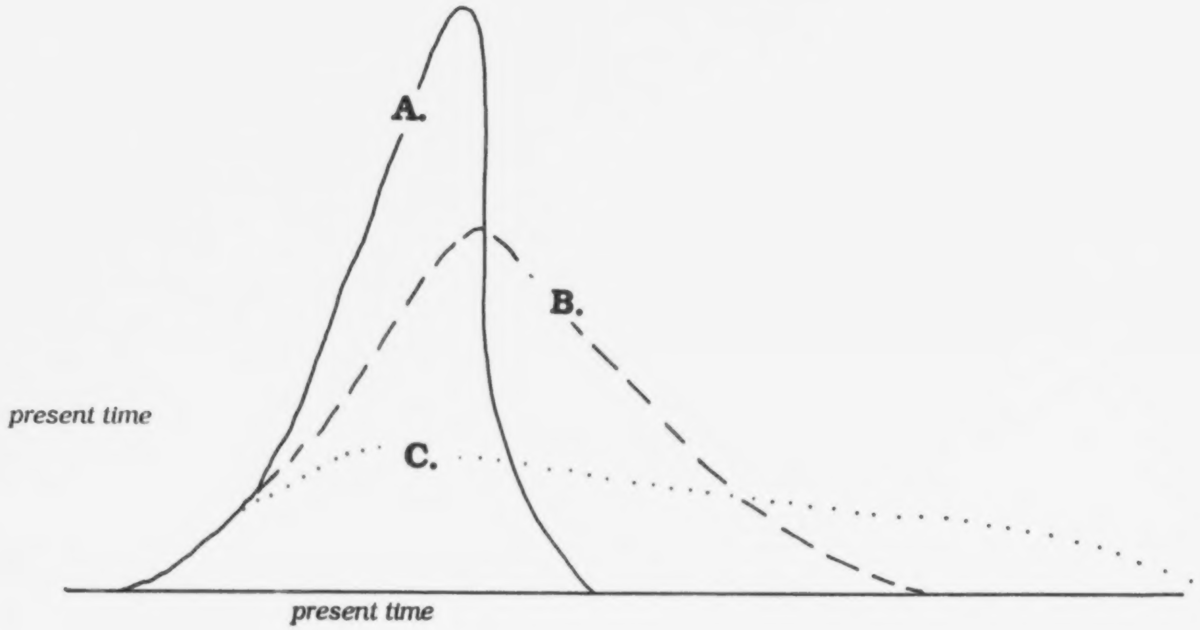
Resource	A. 1986 Reserve Base*	B. Countries or Areas with Highest Reserves		C. Prime Consumers 1974		D. Life Expectancy in Years		E. U.S. Percentage Recycled, 1984
						Static Use at '76 Level	Use Growing at Projected Rates	
Bauxite	23.2 billion metric tons metric ton = 2,200 lbs.	Guinea	26%	U.S.A.	42%	312	63	Aluminum - 25%
		Australia	21%	U.S.S.R.	12%			
		Brazil	15%					
		Jamaica	6%					
Copper	525 million metric tons	Chile	19%	U.S.A.	33%	63	36	42%
		U.S.A.	18%	U.S.S.R.	13%			
		U.S.S.R.	7%	Japan	11%			
		Zambia	6%					
Gold	1,450 million troy ounces	Rep. of S. Africa	53%					35% Refinery production from scrap
		Centrally Planned (Socialist) Economies	20%					
		U.S.A.	8%					
Iron in Ore	98 million short tons short ton = 2,000 lbs	U.S.S.R.	29%	U.S.A.	28%	172	62	Iron & Steel - 23%
		Brazil	20%	U.S.S.R.	24%			
		Australia	11%	W. Germany	7%			
		Canada	9%					
		U.S.A.	5%					
Lead	143 million metric tons	U.S.A.	17%	U.S.A.	25%	37	25	49%
		Australia	16%	U.S.S.R.	13%			
		Canada	15%	W. Germany	11%			
Silver	10.8 billion troy ounces	U.S.A	21%	U.S.A.	26%	20	17	23% Refinery production from scrap
		Canada	19%	W. Germany	11%			
		Mexico	13%					
Tin	3 million metric tons	Indonesia	16%	U.S.A.	24%	41	31	
		China	15%	Japan	14%			
		Thailand	12%					
		Malaysia	12%					
Chromium	7.5 billion short tons (1985)	S. Africa	83%					
Platinum	1.2 billion troy ounces (1985)	S. Africa	81%					

U.S. Recycling Rates for other Commodities:

Paper - 20%
Rubber - 4%
Textiles - 13%

This material borrowed from *A Way With Waste* curriculum guide. A program of the Washington State Department of Ecology

Alternate Depletion Patterns For A Nonrenewable Resource



A. mine, use, and throw away

B. recycle, improve mining technology to damage the environment less and use less concentrated mineral deposits

C. recycle, improve mining, reduce per capita use

SOURCE: Modified after Hubbert 1962 and Cloud 1971.

There is no danger whatever of humanity "running out" of nonfuel mineral resources, and I have not said there is. Humanity is not destroying them. What will run out, however, is the capacity of the environment to absorb the punishment associated with mining ever-lower grades of ore or reconcentrating what is already dispersed. Secondarily, the ability to do the job at an attractive cost will also "run out."

Paul Erlich, *Social Science Quarterly*. Volume 62, No. 1, March 1981.

This material borrowed from A Way With Waste curriculum guide. A program of the Washington State Department of Ecology.

NONRENEWABLE RESOURCES

9-12 ● I.B.1

Name:

Date:

Examine the chart "Selected Nonrenewable Natural Resources: Their Life Expectancy and Prime Consumers." Then answer the following questions.

1. Which column under the heading "Life Expectancy in Years" do you think is more accurate in estimating the length of time our nonrenewable natural resources will last?

2. What are some factors leading to the accelerated use of resources?

3. Examine the "static use" column under the heading "Life Expectancy in Years." Which nonrenewable natural resource will be used up first?

4. Which countries have the highest reserves of the resource? Locate these countries on a world map.

5. Why does the U.S. need to be concerned with the depletion of this resource?

6. Which nonrenewable resource will last the longest according to the static index?

7. According to the projected rates index?

8. Which countries have the highest reserves of this resource?

9. With which countries will the U.S. need to cooperate in order to get the amount of this resource it needs?

10. List the resources that will probably be used up within the next 40 years given projected use rates.

11. What role do recycling and careful use play in extending the availability of these resources?

HOW DO OUR ATTITUDES AFFECT WASTE?

SHOPPER SURVEY

9-12 ● I.C.1

Concept
Each of us is responsible for the size and content of the waste stream.

Objective
Students will assess typical purchasing criteria, determine the influence of packaging on consumer choices, and determine if consumers consider waste disposal and recycling when making purchasing decisions.

Method
Students will survey shoppers in a local supermarket.

Material
Attached worksheet questionnaire.

Subjects
Home Economics, English, Social Studies.

Skills
Communicating, hypothesizing, recording and interpreting data.

Time
20 minutes to introduce activity, homework assignment, one class to discuss and graph results.

Sources
Recycling Study Guide: A Way With Waste.

Resources
Arthur Purcell, *The Waste Watchers.*

AVR Guide Resources

PARALLEL ACTIVITIES

K-3 ● I.C.2 Impressions with E.B. White;

7-8 ● I.C.2 Art Reflecting the Environment.

INFORMATION

I.A.7 Packaging; III.B. Recycling.

RESOURCES

C.8 Plastics and Packaging.

LEADING QUESTION
What things influence our purchasing choices? Why is there so much waste?

PROCEDURE
1. Discuss the leading question. Use the attached questionnaire or develop your own with class to use in interviewing people in a grocery store to find out why they are purchasing the items in their cart. Hypothesize from class discussion what the outcome of the poll will be.

2. For homework, have students interview shoppers, asking each about several items in their cart.

3. As a class, chart and analyze the results of the poll. Compare with class hypotheses. Identify the most common reasons for buying a food product. What percentage of the shoppers were concerned about waste disposal costs and options when deciding what to buy? How often was recyclability taken into account? How many shoppers knew of local recycling opportunities?

(*NOTE*: Students could do this following a local recycling opportunities mapping activity. They could then give shoppers the information they would need to start recycling if they wanted.)

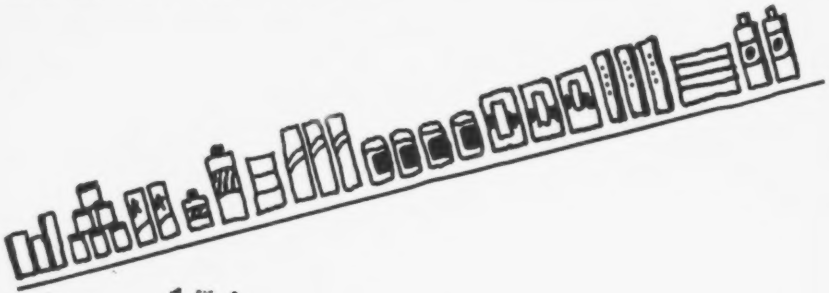
EVALUATION
What are the major influences of consumer habits. How can we change our purchasing habits to reduce solid waste?

EXTENSIONS
A. Have students interview family members to determine the same information as gleaned from the community.

B. Have students write a POSITIVE ACTION CHECKLIST for themselves or for others to help people become aware of solid waste problems and solutions.

C. Publish the class findings in the local newspaper.

D. ACT 78 calls for identification and evaluation of products which cause solid waste disposal problems, as well as consideration of product and packaging bans and/or tax incentives to help alleviate these problems. Find out what the Agency of Natural Resources in currently doing in this area and discuss whether or not you think packaging bans and/or taxes are aviable solution.



Vocabulary: purchasing criteria, recycling, waste stream packaging.

SHOPPER SURVEY 9-12 ● I.C.1

Name: **Date:**

1. Which of the following factors influenced your decision to buy this product?

   a. The cost per pound
   b. the convenience in preparation
   c. you saw it advertised
   d. high nutritional value
   e. lack of artificial coloring, flavoring, or preservatives
   f. the packaging is reusable/recyclable
   g. buying this because you are having company
   h. trying something new
   i. catchy packaging - visually attractive
   j. a friend recommended it
   k. it was on sale
   l. buying it for the kids
   m. uses less packaging than other brands
   n. you're familiar with the brand
   o. you've used this product before
   p. other reasons

2. Does the recyclability of the product or its package play a part in determining what you buy?

3. When buying, do you think of how easy or difficult the product or its package will be to dispose of when you are finished with it?

4. Has this consideration of waste disposal changed at all since the passage of Act 78? Why?

5. Do you know where in this area you could recycle this item?

HOW DOES SOLID WASTE REFLECT SOCIETY?

GARBAGE

9-12 ● I.C.2

Concept
New York City, like every other city in this country, has more garbage than it can cope with.--Katie Kelly.

Objectives
Students will read Katie Kelly's essay. "Garbage." and examine the author's use of analysis and persuasion. Students will use the essay to examine the continuing problems of increasing trash volume and disposal.

Method
After reading this essay, students will discuss and write about how it is written and what information and opinions it contains. They will also consider the garbage issue from the local and national perspective.

Materials
"Garbage" by Katie Kelly and "Garbage" Guide (attached).

Subjects
English, Social Studies.

Skills
Reading, analyzing, discussing, writing.

Time
One class period or more.

Sources
Tom McKone, U-32 High School, East Montpelier; Katie Kelly, "Garbage", *The History and Future of Garbage in America.* Martin Melosi, *Garbage In The Cities;* Wallace Stegner, "The Dump Ground," published in *Wolf Willow* (New York: The Viking Press, 1962).

AVR Guide Resources
PARALLEL ACTIVITIES

K-3 ● I.C.1 Grandparent's Toys;
4-6 ● I.C.1 Then and Now
7-8 ● I.C.1 Trash Timeline.

INFORMATION

I.C Waste and Society.

RESOURCES

C.4 General.

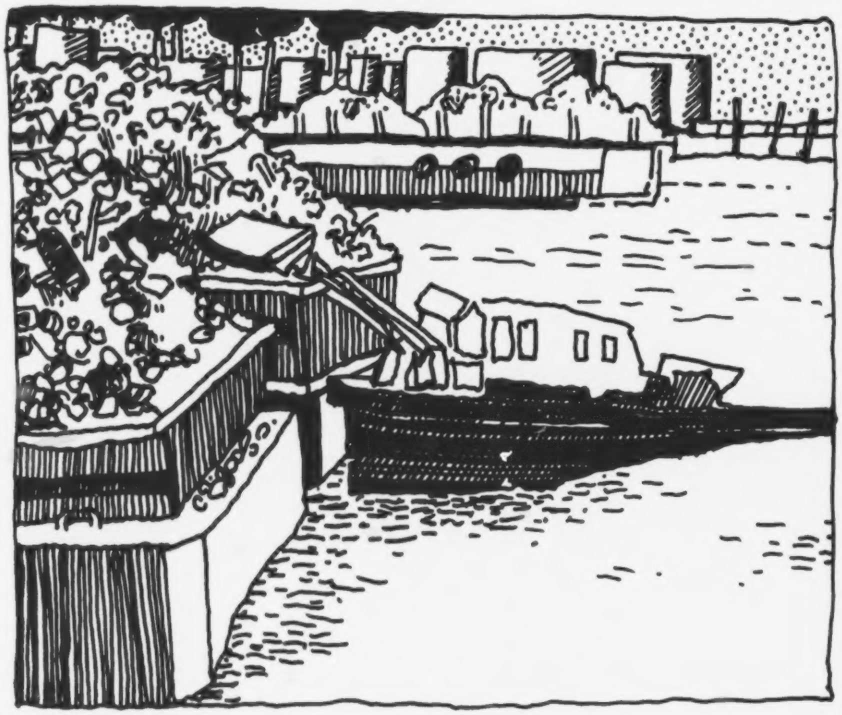
BACKGROUND
Raised in a small Nebraska town, Katie Kelly moved to New York City to work as a freelance writer. This essay was first published in Saturday Review (Sept. 9, 1972), the year before the publication of Kelly's book, The History and Future Of Garbage In America.

LEADING QUESTION
Name something that New York City produces more of than any other city in the world.

PROCEDURE
After the teacher introduces the essay and the subject, students will read the essay, then discuss it and write about it. The teacher may have students write their own process or persuasion essay.

EVALUATION
Teacher's choice.

EXTENSIONS
The teacher may have students investigate and write about or report on any of the research topics on the attached study guide.



Vocabulary: provincial, paltry, flamboyant, mundane, prodigious, residue, forlorn, kill(i.e. in place names).

Name: **Date:**

Study Guide to "Garbage" By Katie Kelly

Questions For Discussion Or Writing:

1. Is the one-word title, "Garbage," appropriate for this essay? Is it misleading? Inadequate? In what way does the generalness of the title add to the meaning of the essay?

2. Find examples that show how Kelly effectively used details and statistics. Why doesn't Kelly state which countries fall behind New York City in garbage production?

3. How does Kelly establish herself as an authority and as a trustworthy reporter?

4. Although "Garbage" is a model analysis of a process and the author never directly states her personal opinion, she carefully sets a tone that makes this into a persuasive essay. What is the tone, and how does she establish it? Where does she stand on this issue? What is her final message?

5. Describe the three major steps of the process outlined in this essay.

6. What is the irony and full significance of "Fresh Kills," the name of the landfill described in the essay. (Check a dictionary to see what "kill" means when it is used in place names.)

7. What is immediately surprising about Fresh Kills? What is not mentioned in the description? What turns Jerome Kretchmer on about Fresh Kills?

8. Although this essay was written in 1972, it does not sound dated. Why not?

9. How does "Garbage" reflect contemporary American attitudes and lifestyles?

RESEARCH TOPICS:

1. How has the garbage situation in New York City changed since this essay was written? Volume? Costs? Landfill situation? Incineration? New problems? New solutions?

2. How does your community dispose of its garbage? How much does the community produce? What does it cost to dispose of it? Where does it go?

3. While describing Fresh Kills, Kelly alludes to F. Scott Fitzgerald's novel, The Great Gatsby. Examine how the ash heaps play an important role in the book.

GARBAGE by Katie Kelly

New Yorkers are a provincial lot. They wear their city's accomplishments like blue ribbons. To anyone who will listen they boast of leading the world in everything from Mafia murders to porno movie houses. They can also boast that their city produces more garbage than any other city in the world. If fact, it produces more than many countries.

In its 1970-71 garbage season--a boffo season if there ever was one--New York City produced an average of 28,900 tons per day, as against a mere 4,800 tons per day for Los Angeles and a paltry 2,000 tons per day for San Francisco. But it is not only in quantity that New York excels. Fully 20 percent of the city's garbage consists of quality paper: canceled checks, rough drafts of Broadway hits, executive memos, IBM punch cards, and so on. On Mondays alone seven million pounds of the Sunday Times are donated to New York garbage cans.

Then there's the packaging. According to the city's flamboyant environmental protection administrator, Jerome Kretchmer, in the rest of the country packaging accounts for under 20 percent of the total garbage; in New York, for 40 percent. Much of this whopping total consists of flip tops, snack packs, variety packs, plastic cases, bottles, tin cans, and other containers. Another big chunk is aluminum. If the aluminum the New Yorkers throw out every day were converted to Reynolds Wrap, it would make a sheet more the 7,500 miles long--roughly than distance from New York to Samoa.

The remaining 40 per cent of Fun City's garbage consists of such mundane leavings as egg shells, coffee grounds, wilted lettuce leaves, and pot scrapings, together with such odds and ends as textile scraps, tires, wood, glass, plastics, etc. (The 73,000 cars abandoned on New York City streets last year constitute a separate class of garbage. Though some find their way to the dump, most of these wrecks are bought up by scrap dealers.)

If New York produces more garbage than any other city in the world, it stands to reason that the cost of getting rid of it must be correspondingly prodigious. It is. Last year the bill for pick up, processing, and delivery came to $176,246,604. Though one would expect innovation from the undisputed leader in the field of garbage, New York is forced to dispose of its trash in ways familiar to every small town in the country: It burns the stuff in incinerators--about 30 per cent on New York City garbage is incinerated--and/or buries it in landfills.

The largest of the city's seven incinerators, the Brooklyn incinerator is a yellow-brick building with high walls, few windows, and two 200-foot-tall smoke stacks, one of which is equipped with an electrostatic precipitator to reduce pollution. (Although a cut above the average in cleanliness, New York's incinerator stacks still spew thousands of pounds of soot over the city every day.) Garbage trucks parade up to the Brooklyn plant, dumping their loads into a pit capable of holding 12,500 ton of garbage. A crane moves back and forth over this pit, periodically clanking down to gouge out a one-ton bite. The crane then drops the garbage into conveyor belts, which in turn feed it into the incinerator ovens.

Measuring thirty by seven by two hundred feet, each of the Brooklyn Incinerator's four ovens is capable of burning up to ten tons of garbage an hour at temperatures averaging 1,600 to 1,800 degrees F. The towering stacks create such an upward draft that, upon looking into one of the iron grates, I felt as if, if I didn't hold on, I would be sucked into that fiery furnace.

After the garbage has been burned, the cooled residue is dumped onto barges, which are towed off by tugboats to one of five landfill sites around the city. The largest of these is the 3,000-acre Fresh Kills site on the Staten Island.

Garbage (continued)

Fresh Kills, which daily receives about 11,000 tons of garbage, is a strange place. Much of this former swampland resembles the ash heaps of The Great Gatsby. Vast, forlorn, endless. A vision of death. In the foreground, a discarded funeral wreath. A doll with outstretched arms. A man's black sock. A nylon stocking. And, beyond, refrigerators, toilets, bathtubs, stoves.

Yet Fresh Kills is also--in places and in its own way--unexpectedly beautiful. Thousands of gulls wheel in the air. Banking sharply, they dip down one by one to settle in for a good feast. In areas where the garbage is fresh, there is an overpowering stench, but where it is older, its blanket of earth is covered with grass, bushes, shrubs, trees. Summertime in Fresh Kills is a time of flowers and birdsong. A volunteer vegetable garden flourishes in the landfill. Here, in the world's largest compost heap, the seeds and sprouts of kitchen scraps thrive. Come fall, offices all around New York's City Hall are decorated with gourds and pumpkins harvested at Fresh Kills. In the fall, too, quail and pheasants scurry through Fresh Kills' underbrush, creating a problem for the Department of Sanitation: Hunters try to poach on the municipal game preserve.

"Fresh Kills turns me on," Jermone Kretchmer said a few days after my visit to the site. Recently, he went on, he had taken his seven-year-old daughter's class out to Fresh Kills for a field trip. Even the sight of the barges heading off for the landfill sites excited him: "You can stand on the shore on Monday morning and watch the barges going out. And you know what went on in New York City over the weekend. There are fetuses and dead cats. Packages, boxes, cartons from fancy stores, dress scraps. Wow, man! Whatever went on in the city is going out to Fresh Kills. You can see it all. What we used. What we wasted."

Opened in 1948, Fresh Kills is already almost full to the brim, for New York City, like every other city in this country, has more garbage than it can cope with. The city is, in fact, due to run out of landfill space--preferably swampland or a sandpit or gulley--in 1985. The solution: Pile it higher. But even here there are limits. As one city official put it: "We have to leave some room between the sea gulls and the planes.

"It sure has changed out here," one worker, who has been at Fresh Kills for years, told me. "Why there used to be fresh natural springs over there. He gestured out over the hundreds of acres of garbage. Natural crab beds once flourished in the area. Now they, too, are gone, buried under tons of garbage.

THE DUMP GROUND

9-12 ● I.C.3

Concept

For a community may be as well judged by what it throws away--what it has to throw away and what it chooses to--as by any other evidence. -Wallace Stegner.

Objectives

Students will summarize themes of one or two essays, and from them will derive, the history and culture of a people. Students will consider and classify various forms of evidence in the study of a culture's past and in the structure of and essay.

Method

Students will read "The Dump Ground" and analyze the author's style, purpose,use of evidence and conclusions. Students will compare these points with Katie Kelly's essay, "Garbage."

Materials

"The Dump Ground" by Wallace Stegner, "Garbage," by Katie Kelly; Study Guide for "Garbage."

Subjects

English, Social Studies.

Skills

Reading, analyzing, comparing, discussing, writing.

Time

One or more class periods.

Sources

Tom McKone, U-32 High School; "The Dump Ground," by Wallace Stegner (included in *Wolf Creek: A History, A Story, And A Memory of the Last Frontier*, New York: The Viking Press, 1962); "Garbage," by Katie Kelly.

Resources

William Rathje, University of Arizona; local historical societies and museums; Lawrence Pringle, *Throwing Things Away;* Martin Melosi, *Garbage In The Cities*.

BACKGROUND

Essayist Wallace Stegner recounts growing up along the U.S. Canadian border around the turn of the century.

LEADING QUESTION

What do people mean when they use the expression, "One man's trash, another man's treasure"?

PROCEDURE

Teachers may use this essay independently or as a follow-up to Katie Kelly's "Garbage." Students will read the essay, then compare the author's style, purpose, use of evidence and conclusions with those of "Garbage." This will begin as a group or class discussion and conclude in written answers to questions or student essays. (See "Garbage" Study Guide.)

EVALUATION

By teacher.

EXTENSIONS

See "Garbage" list.

AVR Guide Resources

PARALLEL ACTIVITIES

K-3 ● I.C.1 Grandparent's Toys;
7-8 ● I.C.1 Trash Timeline.

INFORMATION

I.C Waste and Society.

RESOURCES

C.4 General.

Vocabulary: traverse, artifact, alloy, flume, perambulator, welter, aesthetic.

The Dump Ground by Wallace Stegner

One aspect of Whitemud's history, and only one, and a fragmentary one, we knew: the town dump. It lay in a draw at the southeast corner of town, just where the river left the hills and where the old Mounted Police patrol trail (I did not know that was what it was) made a long, easy, willow-fringed traverse across the bottoms. That stretch of the river was a favorite campsite for passing teamsters, gypsies, sometimes Indians. The very straw scattered around those camps, the ashes of those strangers' campfires, the manure of their teams and saddle horses, were hot with adventurous possibilities. The camps made an extension, a living suburb, of the dump ground itself, and it was for this that we valued them. We scoured them for artifacts of their migrant tenants as if they had been archaeological sites potent with the secrets of ancient civilization. I remember toting around for weeks a broken harness strap a few inches long. Somehow or other its buckle looked as if it had been fashioned in a far place, a place where they were accustomed to flatten the tongues of buckles for reasons that could only be exciting, and where they had a habit of plating the metal with some valuable alloy, probably silver. In places where they had a habit of plating the metal with some valuable alloy, probably silver. In places where the silver was worn away, the buckle underneath shone dull yellow: probably gold.

Excitement liked that end of town better than our end. Old Mrs. Gustafson, deeply religious and a little addled in the head, went over there once with a buckboard full of trash, and as she was driving home along the river she saw a spent catfish; washed in from the Swift Current or some other part of the watershed in the spring flood. He was two feet long, his whiskers hung down, his fins and tail were limp--a kind of fish no one had seen in the Whitemud in the three of four years of the town's life, and a kind that none of us children had ever seen anywhere. Mrs. Gustafson had never seen one like him either. She perceived at once that he was the devil, and she shipped up the team and reported him, pretty loudly, at Hoffman's elevator.

We could still hear her screeching as we legged it for the river to see for ourselves. Sure enough, there he was, drifting slowly on the surface. He looked very tired, and he made no great effort to get away when we rushed to get an old rowboat and rowed it frantically down to where our scouts eased along shore beckoning and ducking willows, and sank the boat under him and brought him ashore in it. When he died we fed him experimentally to two half-wild cats, who seemed to suffer no ill effects.

Upstream from the draw that held the dump, the irrigation flume crossed the river. It always seemed tome giddily high when I hung my chin over its plank edge and looked down, but it probably walked no more than twenty feet above the water on its spidery legs. Ordinarily in summer it carried six or eight inches of smooth water, and under the glassy surface of the little boxed stream the planks were coated with deep sun-warmed moss as slick as frogs' eggs. A boy could sit in the flume with the water walling up against his back, and grab a cross-brace above him, and pull, shooting himself sledlike ahead until he could reach the next cross-brace for another pull, and so on across the river in four scoots.

After ten minutes in the flume he would come out wearing a dozen or more limber black leeches, and could sit in the green shade where darning needles flashed blue, and dragonflies hummed and stopped in the air, and skaters dimpled slack and eddy with their delicate transitory footprints, and there pull the leeches off one by one, while their sucking ends clung and clung, until at last, stretched far out, they let go with a tiny wet puk and snapped together like rubber bands. The smell of the flume and the low bars of the part of the river was the smell of wolf willow.

The Dump Ground (page 2)

But nothing else in the east end of town was as good as the dump ground. Through a historical process that went back to the roots of community sanitation, and that in law dated from the Unincorporated Towns Ordinance of the territorial government, passed in 1888, the dump was the very first community enterprise, the town's first institution.

More than that, it contained relics of every individual who had ever lived there. The bedsprings on which Whitemud's first child was begotten might be out there; the skeleton of a boy's pet colt; books soaked with water and chemical in a house fire, and thrown out to flap their stained eloquence in the prairie wind. Broken dishes, rusty tinware, spoons that had been used to mix paint; once a box of percussion caps, sign and symbol of the carelessness that most of us had in matters of personal or public safety. My brother and I put some of them on the railroad tracks and were anonymously denounced in the Leader for nearly derailing the speeder of a section crew. There were also old iron, old brass, for which we hunted assiduously, by night combing junkmen's catalogs to find out how much wartime value there might be in the geared insides of clocks or in a pound of tea lead carefully wrapped in a ball whose weight astonished and delighted us.

Sometimes the unimaginable world reached out and laid a finger on us because of our activities on the dump. I recall that, aged about seven, I wrote a Toronto junk house asking if they preferred their tea lead and tinfoil wrapped in balls, or whether they would rather have it pressed flat in sheets, and I got back a typewritten letter in a window envelope advising me that they valued my business and were mine very truly. Dazed, I carried that windowed grandeur around in my pocket until I wore it out.

We hunted old bottles in the dump, bottles caked with filth, half buried, full cobwebs, and we washed them out at the horse trough by the elevators, putting in a handful of shot along with the water to knock the dirt loose; and when we had shaken them until our arms were tired, we hauled them down in somebody's coaster wagon and turned them in at bill Christenson's pool hall, where the smell of lemon pop was so sweet in the dark pool-hall air that it sometimes awakens me in the night even yet.

Smashed wheels of wagons and buggies, tangles of rusty barbed wire, the collapsed perambulator that the French wife of one of the town's doctors had once pushed proudly up the plank sidewalks and along the ditchbank paths. A welter of foul-smelling feathers and coyote-scattered carrion, that was all that remained of somebody's dream of a chicken ranch. The chickens had all got some mysterious pip at the same time, and died as one, and the dream lay out there with the rest of the town's short history to rustle to the empty sky on the border of the Hills.

There was melted glass in curious forms, and the half-melted office seat left from the burning of Joe Knight's hotel. On very lucky days we might find a piece of the lead casing that had enclosed the wires of the town's first telephone system. The casing was just the right size for rings, and so soft that it could be whittled with a jackknife. If we had been Indians of fifty years earlier, that bright soft metal could have enlisted our maximum patience and craft, and come out as a ring and medal and amulet inscribed with the symbols of our observed world. Perhaps there were too many ready-made alternatives in the local drug, hardware and general stores; in any case our artistic response was feeble, and resulted in nothing better than crude seal rings with initials or pierced hearts carved in them. They served a purpose in juvenile courtship, but they stopped a good way short of art.

The Dump Ground (page 3)

The dump held very little wood, for in that country anything burnable got burned. But it had plenty of old metal, furniture, papers, mattresses that were the delight of field mice, and jugs and demijohns that ere sometimes their bane, for they crawled into the necks and drowned in the rain-water or redeye that was inside.

If the history of Whitemud was not exactly written, it was at least hinted, in the dump. I think I had a pretty sound notion even at eight or nine of how significant was the first institution of our forming Canadian civilization. For rummaging through its foul purlieus I had several times been surprised and shocked to find relics of may own life tossed out there to blow away or rot.

Some of the books were volumes of the set of Shakespeare that my father had bought, or been sold, before I was born. The had been carried from Dakota to Seattle, and Seattle to Bellingham, and Bellingham to Redmond, and Redmond back to Iowa, and Iowa to Saskatchewan. One of the Cratchet girls had borrowed them, a hatchet-faced, thin eager, transplanted Cockney girl with a frenzy for reading. Stained in a fire, they had somehow found the dump rather than come back to us. The lesson they preached was how much is lost, how much thrown aside, how much carelessly or of necessity given, up, in the making of a new country., We had so few books that I knew them all; finding those thrown away was like finding my own name on a gravestone.

Any yet not the blow that something else was, something that impressed me even more with how closely the dump reflected the town's intimate life. The colt whose picked skeleton lay out there was mine. He had been incurably crippled when dogs chased our mare Daisy the morning after she foaled. I had worked for months to make him well, had fed him by hand, curried him, talked my father into having iron braces made for his front legs. And I had not known that he would have to be destroyed. One weekend I turned him over to the foremen of one of the ranches, presumably so that he could be better cared for. A few days later I found his skinned body, with the braces still on his crippled front legs, lying on the dump. I think I might eventually have accepted the colt's death, and forgiven his killer, if it had not been for that dirty little two-dollar meanness that skinned him.

Not even finding his body cured me of going to the dump, though our parents all forbade us on pain of cholera or worse to do so. The place fascinated us, as it should have. For this was the kitchen midden of all the civilization we knew. It gave us the most tantalizing glimpses into our neighbors' lives and our own; it provided an aesthetic distance from which to know ourselves.

The town dump was our poetry and our history. We took it home with us by the wagonload, bringing back into town the things that town had used and thrown away. Some little part of what we gathered, mainly bottles, we managed to bring back to usefulness, but most of our gleanings were left lying around barn or attic or cellar until in some renewed fury of spring cleanup our families carted them off to the dump again, to be rescued and briefly treasured by some other boy. Occasionally something we really valued with a passion was snatched from us in horror and returned at once. That happened to the mounted head of a white mountain goat, somebody's trophy from old times and the far Rocky Mountains, that I brought home one day. My mother took one look and discovered that his beard was full of moths.

I remember that goat; I regret him yet. Poetry is seldom useful, but always memorable. If I were a sociologist anxious to study in detail the life any community I would get very early to its refuse piles. For a community may be as well judged by what it throws away--what it has to throw away and what it chooses to-- as by any other evidence. For whole civilizations we sometimes have no more of the poetry and little more of the history than this.

GNP(P): Great New Purchasing Power

9-12 ● I.C.4

Concept
Economic success encourages increased energy consumption

Objective
Students will be able to detect general relationships between GNP/capita and energy consumption per capita, and will examine the specific factors which encourage high energy use. Students will understand relationships between recycling and conserving energy.

Method
Students will analyze tables and charts showing GNP/energy usage patterns.

Materials
Charts and tables: "Toast" (film)

Subjects
Science, Social Studies, Math.

Skills
Graphing, analyzing.

Time
One class period.

Sources
A Way With Waste; Workshop; *EME Handbook*; Green Mountain Power Corporation.

Resources
Energy Information Center, Vernon, VT (800) 248-9015; *Oxford Economic Atlas of the World, 4th Edition.* London: Oxford University Press, 1972; local electric utilities.

AVR Guide Resources

PARALLEL ACTIVITIES

K-3 ● I.C.2 Impressions with E.B. White;

7-8 ● I.C.2 Art Reflecting the Environment.

INFORMATION

I.A The Solid Waste Stream;

I.B Waste and Natural Resources.

RESOURCES

B.5 Environmental Groups;

C.4 General.

BACKGROUND

If you drink two cans (aluminum) of beer or soft drinks per day and fail to recycle the cans, you waste more energy than is used daily by each of a billion human beings in poorer lands.

--ConservAction, 1978 Family Energy Watch Calendar.

Throwing away an aluminum beverage container wastes as much energy as filling the same can half full of gasoline and pouring it out on the ground. Failing to recycle a daily edition of the New York Times or the Washington Post wastes just as much.

--William Chandler, "Six Ounces of Gasoline in a Soda Can."

LEADING QUESTION

Does a higher income cost more?

PROCEDURE

1. Read the above quotes to students. Then view the movie "Toast."

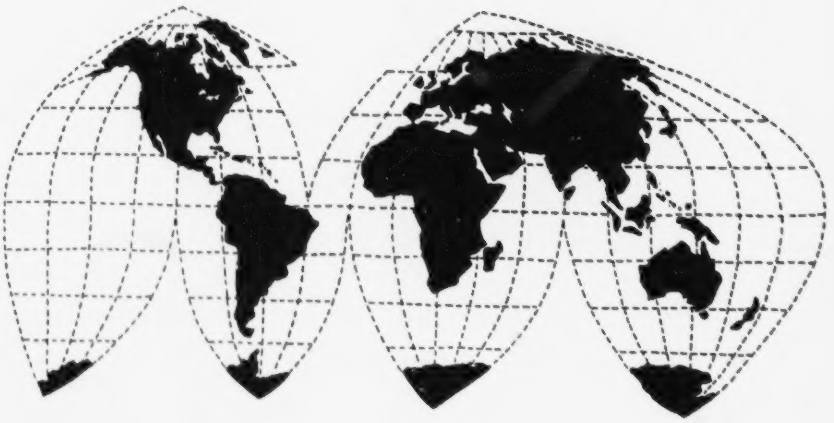
2. Reproduce and distribute the attached charts. Have students graph the data. Discuss the attached questions or have students answer them on the worksheet.

EVALUATION

What country uses the most energy per person? Why? name three countries with a GNP of less than $300 per year. Do you think these countries have a high or low level of energy use per person? Why?

EXTENSIONS

A. Have students do the attached handout, "How Can We Personally Conserve Energy?"



Vocabulary: gross national product, energy consumption, energy conservation.

GNP(P): Great New Purchasing Power 9-12 ● I.C.4

Name: **Date:**

U.S. Environmental Benefits of Recycling[4]

	Paper	Aluminum	Iron and Steel
Energy Use Reduction	30-55%	90-95%	60-70%
Spoil and Solid Waste Reduction	130%*	100%	95%
Air Pollutoin Reduction	95%	95%	95%

* NOTE: More than a 100 percent reduction is possible because 1.3 pounds of waste paper are required to produce one pound of recycled paper. If all paper were recycled, the waste reduction, of course, would equal only 100 percent.

Country	1981 GNP/Capita (in U.S. $)	1972 Annual Energy Units* Per Capita**
Afghanistan	-	23
Argentina	2,560	1,490
Brazil	2,214	435
Burundi	235	9
Canada	11,230	7,870
Egypt	654	241
Ethiopia	142	34
France	12,130	3,314
Greece	4,540	1,240
Haiti	297	24
India	253	157
Japan	10,330	2,755
Laos	-	71
Mali	185	21
Nepal	156	8
Pakistan	349	68
Saudi Arabia	12,720	813
Sweden	14,500	5,140
Switzerland	17,150	3,015
United States	12,530	9,500
South Yemen	512	11

Chart From Energy, Food and You.

NOTE: A "-" indicates information not available

*Each Energy Unit (EU) is equivalent to one ten thousandth of the energy expended by the average American in 1972. To be more specific, one EU is 34,300 British thermal units or around 10 kilowatt hours.

**More recent figures were unavailable. Therefore, an up-to-date direct correlation between GNP per capita and energy units per capita cannot be assumed.

This material borrowed from *A Way With Waste* curriculum guide. A program of the Washington State Department of Ecology.

GNP(P): Great New Purchasing Power 9-12 ● I.C.4

Name: **Date:**

1. From the relationship between energy consumption and GNP/capita shown by your graph, what general statements can you make?

2. Separate the listed countries into three groups (high, medium, and low GNP/capita) at what appear to be natural dividing points. Now, looking only at the energy/capita column, divide the countries into three groups at what also appear to be natural dividing points. How close to being identical are your groups when done by GNP/capita and then energy/capita?

3. Look at your groupings and make some observations about the countries in each group. Consider such topics as geographic location, availability of resources, political systems, economic systems, and cultural factors.

4. On your graph you can see that Sweden, Canada, Saudi Arabia and the United States are close in GNP/capita but have widely varying levels of energy consumption. Make some observations about why you think this discrepancy occurs. Consider their levels of industrialization, history, cultural preferences, availability of resources, political systems and geography.

5. If greater economic success encourages greater energy consumption, what problems do you foresee for the world's developing nations?

6. As each raises its standard of living, what are the implications? Do you think this increased energy expenditure is mandatory -- that is, is it possible to be economically successful as a country and not significantly increase energy consumption? Why and how? or why not?

Name: **Date:**

How can we personally conserve energy?

Using the attached list, check off the appliances you and your family use. List any others not included. (Check for wattage printed on the UNPLUGGED appliance.)

Estimate your hours of usage and find the total consumption per day. Then check off the appliance you think you could do without. Compare the new list with the orginal. What are the environmental costs per kilowatt hour consumed?

Item	Average Wattage
Air conditioner	1,566
Blanket, electric	177
Boiler	1,436
Clock	2
Clothes dryer	5,000
Coffee maker	1,225
Dehumidifier	257
Dishwasher	1,201
Disposal (sink)	445
Fan	200
Food blender	386
Food freezer, (15-21 cu. ft., conventional)	375
Food freezer (15-21 cu. ft., frost-free)	562
Frying pan	1,196
Heater, portable	1,322
Humidifier	117
Iron	1,088
Lighting	100
Microwave oven	1,500
Personal computer	50
Radio	71
Range	12,207
Refrigerator (16-18 cu. ft., frost-free)	615
Self-cleaning oven	2,500
Sewing machine	75
Television, color	332
Toaster	1,146
Vacuum cleaner	630
VCR	40
Washing machine	512
Water heater, quick recovery	4,500

HOW DO LANDFILLS WORK?

NEW LANDFILLS

9-12 ● II.B.1

Concept
It is complicated and controversial to properly site a new landfill.

Objective
Students will become familiar with local government, land-use planning, and complexities of the solid waste planning process.

Method
Students will simulate the siting of a landfill in their area.

Materials
Town and state topographical, geologic and soils maps, local zoning regulations, landfill regulations from ANR.

Subjects
Science, Social Studies.

Skills
Formulating questions, predicting, problem solving, recording and interpreting data, planning.

Time
Several weeks.

Source
Workshop.

Resources
The Technology of Trash (video or film); ANR; town clerks; regional planning commissions; solid waste district; local engineers; UVM Extension Service; *State of Vermont Solid Waste Plan; State of Vermont Solid Waste Rules*, Lawrence Pringle, *Throwing Things Away;* Geraldine and Harold Woods, *Pollution.*

AVR Guide Resources

PARALLEL ACTIVITIES

4-6 ● II.B.1 Landfills;
7-8 ● II.B.1 Mini Landfills;
7-8 ● II.B.2 Landfill Soil;
9-12 ● II.B.2 Methane.

INFORMATION

II.B.2 Landfills;
II.C Public Planning and Policy.

RESOURCES

A.3 Solid Waste Districts;
A.5 Landfills.
A.10 Vermont Businesses

BACKGROUND
Many Vermont communities are facing closing landfills and must find alternative disposal methods. While recycling and composting can divert a substantial portion of the waste stream, and incineration and other processing methods can further decrease the volume and weight of trash, there will always be a need for land disposal of the residuals. Siting new landfills is difficult because there are so manu geological, social and political factors to consider. The location of existing and planned land developments, protection of ground and surface water, road suitability and accessibility by haulers, opposition of local residents, the expense of current landfill construction, and other problems all make siting a new landfill controversial and complicated.

LEADING QUESTION
If we need a new landfill, how will we go about siting and designing one?

PROCEDURE
1. Review how landfills work and the potential problems involved. Obtain current requirements for sanitary landfills from the Agency of Natural Resources.

2. Determine the local landfill history and schedule for closure.

3. Determine current and projected pollution and waste generation figures. How many communities will the landfill serve? How many residents and businesses will be contributing to the waste stream? What are the current and projected levels of recycling? Are any other waste processing facilities existing or planned? What will their effect be on the size of the waste stream?

4. Determine local geology and current land use plans and restrictions.
5. To determine the size landfill required, assume the following:
   - a. Each resident produces 2 pounds of trash each day or 730 pounds per year.
   - b. 800 pounds = one cubic yard (approximate trash produced per person per year.)
   - c. One acre of landfill space, ten feet deep = 16,133 cubic yards capacity.
   - Determine volume for the number of people your landfill will be serving. Determine the length of time the landfill will be in operation. Ten years, fifty years?
   - Determine number of acres needed.

6. Based on the above considerations, write a proposed plan for a new landfill. Compare with other proposals and with what your town and/or solid waste district is proposing.

EVALUATION
What is the current landfill situation facing your community? List the major considerations in siting and designing a new landfill.

EXTENSION
A. Design a use for the old landfill once it is closed.

Vocabulary: landfills, siting.

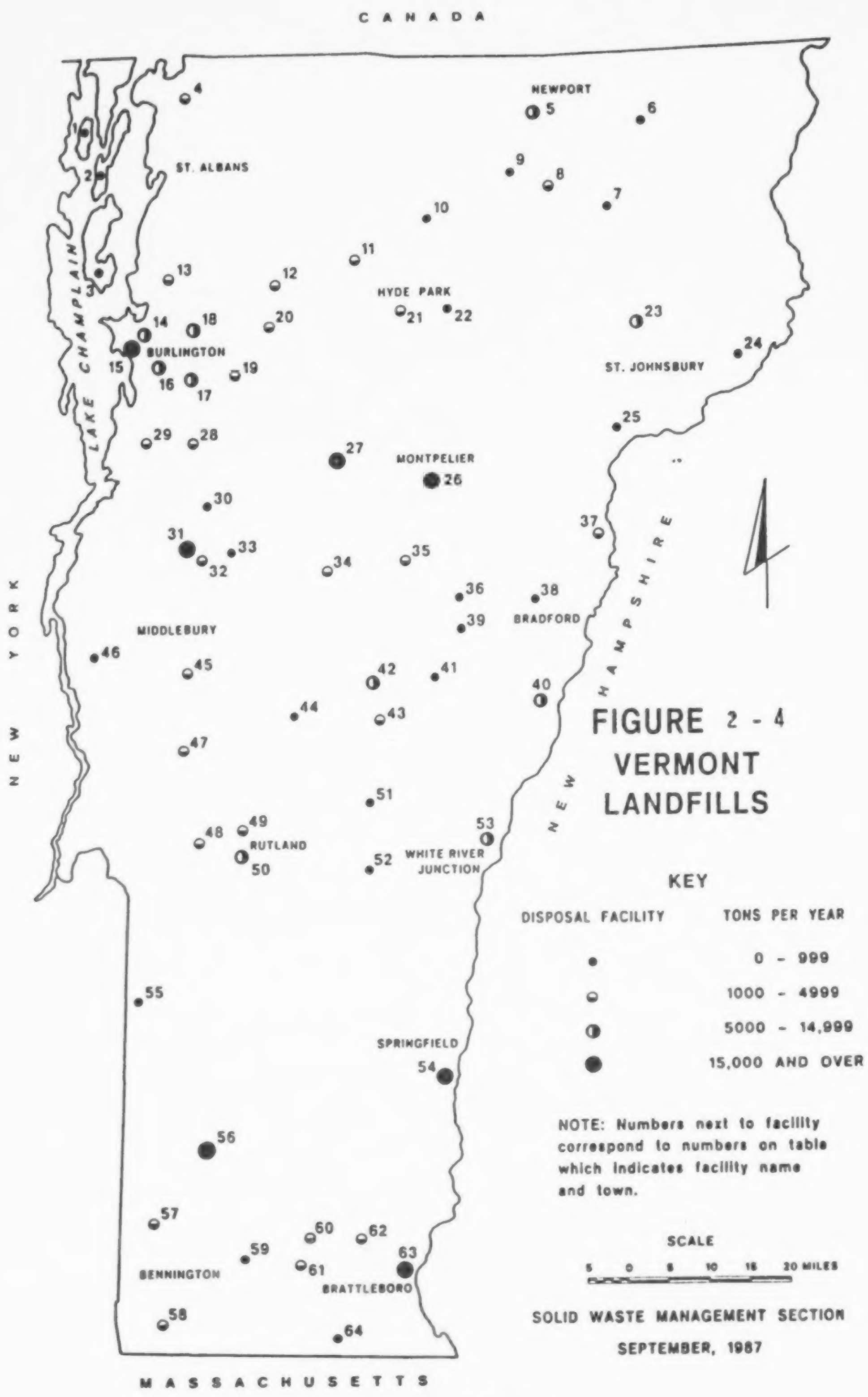


FIGURE 2 - 4
VERMONT
LANDFILLS

KEY

DISPOSAL FACILITY	TONS PER YEAR
•	0 - 999
◒	1000 - 4999
◑	5000 - 14,999
●	15,000 AND OVER

NOTE: Numbers next to facility correspond to numbers on table which indicates facility name and town.

SCALE
5 0 5 10 15 20 MILES

SOLID WASTE MANAGEMENT SECTION
SEPTEMBER, 1987

HOW CAN WE RECOVER ENERGY FROM SOLID WASTE?

METHANE

9-12 ● II.B.2

Concept
Energy can be recovered from waste.

Objective
Students will understand the energy-producing potential of some solid wastes and will understand some systems of generating methane from waste.

Method
Students will construct a classroom-size model methane generator.

Materials
Three beakers, vaseline, organic slurry, balloon, three rubber stoppers, one foot of glass tubing or a "U" tube, 3 feet of surgical tubing, the nozzle form a medicine dropper, one pinch clamp.

Subjects
Science, Social Studies.

Skills
Experimenting, hypothesizing, observing, predicting, recording and interpreting data.

Sources
A Way With Waste; Arthur Purcell, *The Waste Watchers*.

Resources
Waste Wise (slide show); *Light at the end of the Pipe* (video); "The Fascinating World of Trash" *National Geographic*.

AVR Guide Resources

PARALLEL ACTIVITIES

4-6 ● II.B.1 Landfills;
7-8 ● II.B.1 Mini Landfills;
7-8 ● II.B.2 Landfill Soil;
9-12 ● II.B.1 New Landfills.

INFORMATION

II.B.2 Landfills.

RESOURCES

A.5 Landfills.

BACKGROUND

Once buried, organic wastes decompose anaerobically. Carbon dioxide, methane, ammonia, and hydrogen sulfide gases are all produced as microorganisms break waste down. trapped beneath the landfill surface, these gases become potential health and safety threats if not properly vented. To avoid explosions or lateral migration of methane beneath the surface of the landfill, vents are installed to reduce pressure build-up of the gases.

Methane is the largest component of natural gas. If the landfill volume is great enough (at least one million tons), the methane produced can be captured, purified by removing carbon dioxide and water, and sold to gas utility supplies. Capturing methane from landfills may not turn a profit, but it can help to defray the landfill's operating costs. There are at least thirty methane recovery systems operating or under construction in the United States, and at least thirty methane recovery systems operating or under construction in the United States, and at least one thousand landfills large enough to handle a methane recovery system. However, any proposal for such a facility in Vermont would require substantial documentation to determine its costs and potential environmental impacts.

LEADING QUESTION

Can we recover energy from solid waste?

PROCEDURE

1. Fill digester about one half full with an organic slurry (i.e. manure and/or ground grass clippings, etc. mixed with water until a thick, but pourable, consistency is reached.) Keep it warm. Wear safety goggles.

2. Bore two holes in a rubber stopper with a cork borer.

3. Run a tube to a gas storage container. (NOTE: Make sure all connections are tight. Use vaseline on cork holes.) The container's lid should have two holes, one for the tube coming from the digester and one for a nozzle and clamp-- this is your flare.

4. Run a tube to a pressure relief system. Use an easily expandable container or a balloon that's been blown up several times. Make sure tube from digester extends down into water. This arrangement will prevent an excess of has from feeding back into the digester.

5. Build four or five, and have students test different organic wastes. Which produces the most gas the fastest? Which waste produces the best fuel?

EVALUATION

What is methane? How is it produced? List materials that can be used to generate methane. Describe another means of using solid waste to produce fuel.

Vocabulary: methane, slurry, anaerobic, decomposition.

EXTENSIONS

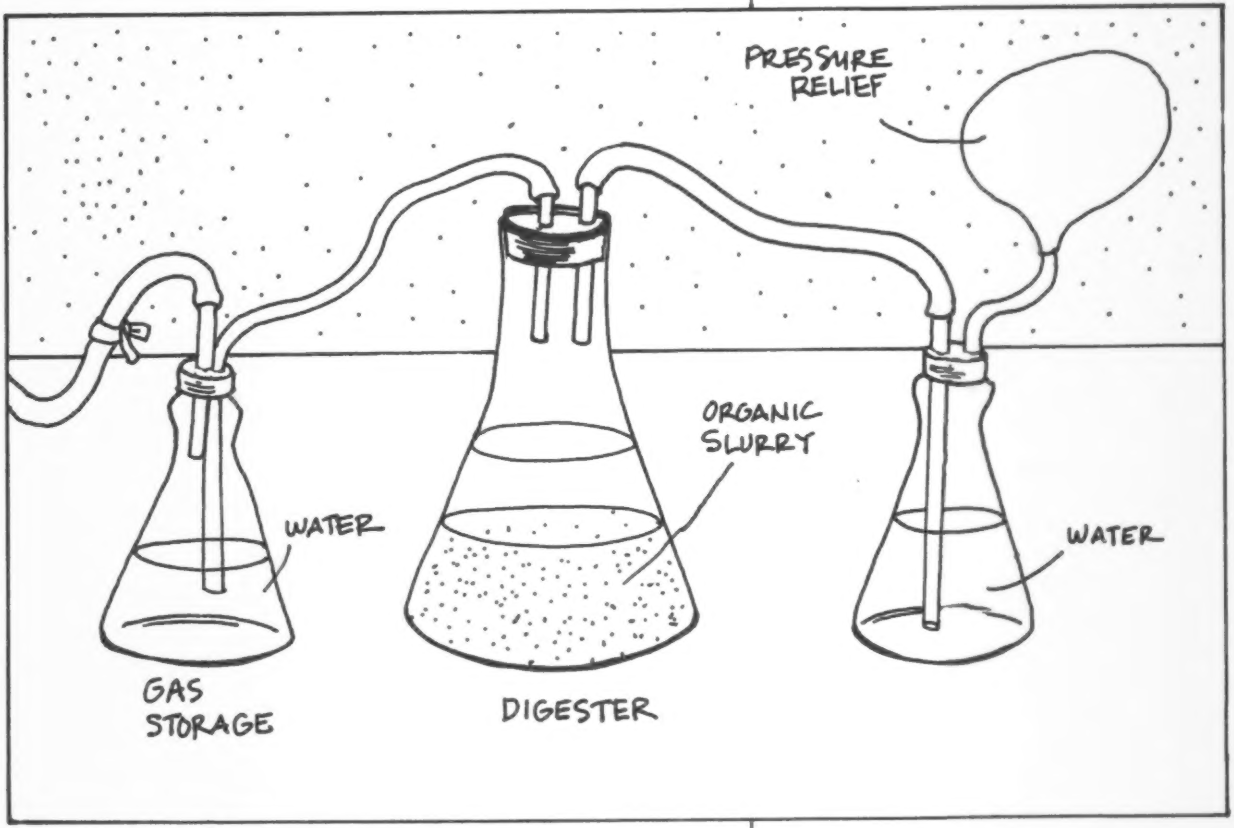
A. Have students research the historical uses of methane gas digesters. For example, in Holland a tarp was placed over a portion of a swamp with a hose running from under the tarp to the house for light and heat.

B. Research modern methane technology.

1. use of digester at Monroe Reformatory Honor Farm, Monroe, Washington.

2. use of basic design in India/Pakistan/China for small scale home heating/cooking/lighting. See "The Fascinating World of Trash," *National Geographic* (April 1983).

C. Study resource recovery technology to learn how industrial fuel is created from solid waste by pyrolosis.



SPREADING SLUDGE

9-12 ● II.B.3

Concept
Sewage sludge and manure can be applied to the land to reduce solid waste and return nutrients to the earth.

Objective
Students will determine the benefits and drawbacks of land application of sewage sludge.

Method
Students will gather information on quantities and methods of sludge disposal in their communities.

Material
No special materials.

Subjects
Social Studies, Science.

Skills
Interviewing, formulating questions, hypothesizing.

Time
One class period for presentation, three days of research.

Sources
Workshop; *State of Vermont Solid Waste Plan* (March 1988 draft); *Carolyn Jabs, RE/USES.*

Resources
Local engineering firms; local sewage treatment facilities; local residents; firms who produce fertilizer from sewage sludge.

LEADING QUESTION
Is it safe to put sludge on the land all year round?.

PROCEDURE
1. Contact sewage treatment plant operators and sanitary engineers.
2. Interview farms where sludge is applied.
3. Interview neighbors.

EVALUATION
Students should be able to discuss the nature of sludge material, and the advantages and disadvantages of land application. Evaluate school grounds for sludge application.

EXTENSIONS
A. Invite a waste management engineer to the class to explain site selection for sludge spreading.

B. Students can investigate sludge composting systems and brainstorm ways to recycle organic wastes on a large scale.

C. Research different composting toilets and design a composting toilet system for a Vermont home or camp. Visit Vermont homes already using this method. What are the benefits and drawbacks?

D. Investigate sources of commercially-available compost.

E. Investigate alternative wastewater treatment technologies. See "The New Alchemist" by Donella Meadows in the December 1988 issue of *Harrowsmith.* Take a field trip to the Sugarbush Solar Aquatic Wastewater Purification System in Warren, VT.

Vocabulary: sewage, sludge, land application.

SPREADING SLUDGE

One large component of the waste we produce daily is our bodily waste. Because of modern plumbing and septic systems, we are able to conveniently divorce ourselves from the product of our biological functions. However, each time we flush a toilet, we typically send about five gallons of clean water, as well as matter full of minerals and nutrients, down the drain. Both water and rich organic matter are wasted. Of the 25 billion gallons of sewage sludge produced daily in the U.S., 15% goes into the ocean, 35% is burned, 25% is buried, and the remaining is composted.

Most Vermont residences use household septic tanks-leach field systems, to treat their septic wastes. Other on-site treatment includes dry wells, outhouses and composting toilets. The remaining 47% make use of one of the 91 municipal and 36 non-municipal sewage treatment plants, 136 drinking water treatment plants, and 59 septate haulers. Various industrial activities such as papermaking and cheese making also generate sludges requiring treatment and disposal.

Sewage can be processed and used as soil conditioner, an option more communities are taking advantage of to save disposal costs and the nutrient value in sewage. Sewage sludge is dewatered and composted to produce soil conditioner or fill. Once sterilized, the material can be used as fill in landfills or spread on fields.

Most of Vermont's sewage sludge is applied to agricultural land except in winter. Spreading sludge on land maximizes its soil enriching value and lessens the concentration of potentially hazardous materials. In winter, sludge must be stored to prevent pollution. There are currently 13 sewage treatment plants with sludge storage facilities.

Septic sludge contains pathogenic (disease-causing) bacteria, viruses and other microorganisms from human wastes. Soil conditioners made from septic wastes fed with commercial industrial waste are often contaminated with heavy metals such as cadmium, mercury, as well as pesticides, such as DDT, and PCBs. There is differing opinion as to whether sludge and/or compost from this kind of sludge poses a health threat. The State of Vermont Solid Waste Plan (March 1988 Draft) Natural Resources, for instance, suggests that land application of sludge "disperses any potentially harmful constituents of concern to public health." Nonetheless, such sludge should never be used on land producing crops for human consumption.

Treated or composted sludge can also be packaged and sold as organic fertilizer. Products made in this way include Nu-Earth from Chicago, Milorganite from Milwaukee, ORGRO from Schenectady, and Metroloam from Boston. (RE/USES: p.13, 15) One Vermont company recently announced that it intends to compost whey sludge in St. Albans to produce an Vermont organic fertilizer for the national market.

TOXIC WASTE IN THE LAB

9-12 ● II.B.4

Concepts
Safe disposal of common toxic substances is expensive and difficult; inappropriate disposal can harm the environment and people.

Objective
Students will upgrade the school's lab cabinet.

Method
Students will select some waste chemicals or unneeded chemical supplies for neutralization.

Material
Selected chemicals, safety goggles, Flinn Catalog.

Subjects
Chemistry.

Skills
Lab technique.

Time
Varies-- some procedures are several days long.

Source
Workshop.

Resources
Flinn Scientific Inc. Catalog, PO Box 219, Batavia, IL 60510 (312-879-6900); Ken Giles, *School Science Laboratories: A Guide To Some Hazardous Substances*. (Free from U.S. Consumer Product Safety Commission, 5401 Westbard Avenue, Bethesda, MD 20207 (301) 492-6580.

AVR Guide Resources

PARALLEL ACTIVITIES
K-3 ● I.A.4 What's Hazardous?

RESOURCES
A.11 Environmental Groups;
C.1.b Curricula;
C.9 Household Hazardous Waste.

BACKGROUND
Many chemical experiments formerly done at the high school level are no longer done because of safety concerns. Chemicals produced in many labs cannot be disposed of easily. Neutralization is often the best solution--to remove the chemical from the waste stream before it is mixed in with other wastes.

LEADING QUESTION
Are there alternatives to disposal of toxic wastes in the solid waste stream?

PROCEDURE
1. Select a chemical for neutralization. Use either a product of a lab or a chemical bottle from the chemical cabinet that is old or for which no use is planned.

2. Follow neutralization plan in Flinn Catalog.

NOTE: Some procedures should be demonstration only.

EVALUATION
Given a certain chemical, have students, explain the neutralizing process, and the chemistry behind each step.

EXTENSIONS
A. Do a complete inventory of the chemical cabinet and rate dangers using the Flinn Catalog. Organize the cabinet correctly using the Flinn explanations, and date all chemicals.

B. Research how to set up a household hazardous waste collection program for your community.

Vocabulary: toxic, hazardous, neutralization, chemicals.

COMMUNITY SOLID WASTE

9-12 ● II.C.1

Concept
Beginning to solve solid waste problems requires understanding our community's present solid waste management practices and future plans.

Objective
Students will evaluate both the current solid waste disposal practices and the future solid waste plans in their community.

Method
Students will interview local recyclers, solid waste management planners and state officials to determine the status of solid waste management planning in their community.

Materials
Copies of Act 250 and Act 78.

Subjects
Social Studies, Science.

Skills
Researching, interviewing.

Time
Several days.

Source
A Way With Waste.

Resources
Town officials; local landfills and transfer stations; regional planning commissions; solid waste districts; recycling groups and businesses; EPA; ANR.

AVR Guide Resources
INFORMATION
II.C Public Planning and Policy; III.B Recycling; III.C Composting.

RESOURCES
A. Vermont Resources; C.4 General.

LEADING QUESTION
How do we manage our solid waste?

PROCEDURE
1. Use the following questionnaires to guide an exploration of solid waste management in your community.

2. Contact recyclers, landfill site manager, disposal company representatives, county environmental health officers and planning officials. Invite officials to speak to the class.

EVALUATION
Where does your waste material go for disposal? What is the cost your household pays for solid waste disposal? What are the real costs of this disposal and who pays them? How much does your town pay for disposal, including pickup, hauling, and landfilling/incinerating?

EXTENSIONS
A. Write an alternative solid waste management plan for your community as you think it should be or make suggestion to your solid waste district commission member.

Vocabulary: solid waste management, planning.

Name: **Date:**

1. Find out the following as it applies to your community:
   a. Quantities and types of material discarded

   b. Where materials are finally disposed

   c. Quantities and types of material recycled, reused, and recovered

   d. Expense of solid waste disposal

2. Determine your community's plans for future solid waste disposal by asking:
   a. How and where will solid waste be handled/disposed of in the future (landfills, energy production, recycling, etc.)?

   b. How will future disposal sites by chosen?

   c. What quantities of solid wastes will be generated in the future (more or less than at present)?

   d. What will happen to the cost of solid waste disposal in the future?

3. Evaluate your findings regarding your community's plans for solid waste disposal.
   a. From your perceptions of the solid waste disposal situation, do you feel that your community has made adequate preparations for the future?

   b. If you had the ability to change any aspects of the plan for future solid waste disposal your community, what would you do?

   c. From your research, make recommendations on how individuals in your community might become involved in determining future courses of action regarding solid waste disposal.

   d. What individual action might you take to alleviate the problem of solid waste in your community?

HOW SHOULD WE GET RID OF OUR TRASH?

WASTE MANAGEMENT CHOICES 9-12 ● II.C.2

Concept
There are many different disposal methods available to communities; each has its own benefits and drawbacks.

Objective
Students will explain basic components of different waste management technologies available and will compare benefits and drawbacks of each method.

Method
Students will research waste processing technologies and present their findings to the class.

Material
Posterboard and markers for diagrams.

Subjects
English, Math, Science, Social Studies.

Skills
Communicating, formulating questions, problem solving, role playing.

Time
A week or more for research, one class period for presentation.

Resources
Vicon in Rutland; Wheelabrator Waste-to-Energy in Claremont (NH/VT Solid Waste District); VPIRG; ANR; Solid Waste Districts; Planning Commissions.

AVR Guide Resources

PARALLEL ACTIVITIES
4-6 ● II.C.1 Solid Waste Bulletin Board.

INFORMATION
II.B Treating and Disposing of Waste; II.C Public Planning and Policy; III.B Recycling; III.C Composting.

RESOURCES
A. Vermont Resources;
C.5 Recycling;
C.6 Composting;
C.7 Incineration.

BACKGROUND
According to the Vermont Solid Waste Plan, all regional planning commissions must come up with a plan to manage their wastes by July 1, 1990. According to Act 78, these plans are to be based on the following priorities in descending order:

(a) the greatest feasible reduction in the amount of waste generated
(b) reuse and recycling of waste to the greatest extent feasible **the volume remaining for processing and disposal;**
(c) waste processing to reduce the volume necessary for disposal; and
(d) land disposal of the residuals.

LEADING QUESTION
What is the best way to dispose of our solid waste?

PROCEDURE
1. Break students into groups and assign one of the following technologies to each group to research.

- mass-burn incineration
- material recovery facilities
- composting and recycling
- incineration without energy recovery
- landfills

Student should evaluate the technologies in light of:

1) the four waste management priorities outlined in the Vermont Solid Waste Law,

2) how much and what types of waste their town and solid waste district are currently generating and how they are disposing of it (see 9-12 ● II.C.1 COMMUNITY SOLID WASTE), and

3) environmental, economic and political problems encountered with each. They might use the following list of questions to guide their research.

2. Have each group select a spokesperson to present their findings to the rest of the class. (This could be done by role-playing a regional solid waste district meeting at which representatives from different waste management firms give presentations on their product, and at which the district can respond to the sales pitch with their concerns.)

EVALUATION
Students should be able to describe the different waste management technologies and list at least five benefits and drawbacks to each as a local waste management option.

EXTENSIONS
A. Visit a waste-to-energy plant and/or ask a spokesperson from a waste-to energy plant or company representative to come talk to your class.

B. Survey community opinion on the subject. Present a report of your findings to local government.

Vocabulary: mass-burn, incineration, resource recovery, composting, ACT 78.

WASTE MANAGEMENT CHOICES

Name: **Date:**

Type of waste management technology: ____________________

1. What percentage of the waste stream can this process handle?

2. What are the costs per ton of processing the waste?

3. What is the projected lifetime of the facility?

4. What is the expense of constructinG the facility and how can it be financed?

5. What is the estimated cost of maintenance and who will pay these costs?

6. What, if any, are the environmental or public health problems associated with the technology?

7. Is the method convenient and will the public endorse its use and participate in it operation?

8. Does this technology allow for and encourage the greatest reduction, reuse, and recycling of the waste stream prior to treatment and disposal, as prescribed by ACT 78?

9. Is this technology well suited to your area? Can you recommend its use for your solid waste district?

TWENTY FOOT SWATH

9-12 ● III.A.1

Concept

Each person on every level of society, industry and government contributes to our solid waste problems and can help solve them.

Objective

Students will discern the author's purpose in the essay and will develop a plan for decreasing pollution in their environment by setting realistic personal goals.

Method

Students will read an essay, develop and adopt A personal positive action plan and record the results in journal and essay form.

Materials

Attached essay.

Subjects

English, Health, Social Studies.

Skills

Values clarification, brainstorming, problem solving, writing.

Time

One class to start, a few weeks journal writing out of class, one class to end.

Sources

A Way With Waste; Kenneth Lundberg, "My Twenty Foot Swath", *The Covenant Companion*.

Resources

Charles Butterfield/Social Values.

AVR Guide Resources

PARALLEL ACTIVITIES

K-3 ● III.A.1 Egg Cartons;
4-6 ● III.A.1 Wise Use of Paper;
7-8 ● III.A.1 Packaging Design.

INFORMATION

II.C Public Planning and Policy;
III.A Recycling.

BACKGROUND

People are not powerless in the face of these complex problems. By reducing the amount of waste they produce and recycling a large share of their discards, individuals can become part of the solution. But consumers cannot effect widespread changes on their own. They need the assistance of industries willing to manufacture recyclable products and governments willing to alter their waste management practices. The cumulative waste management decisions made by local and national governments affect global energy use, the rate at which the atmosphere warms, and the amount of pollution emitted into the environment. The degree to which people and nations act together to conserve raw materials and energy resources will determine the rate at which the global environment is altered.

-- Cynthia Pollack, 1987.

LEADING QUESTION

Have personal or global problems such as poverty or environmental pollution ever become so overwhelming that you were immobilized or driven to some action that actually aggravated the problem?

PROCEDURE

1. Discuss the above question. List areas which apply.

2. Have students read the article and discuss.

3. Have students relate similar personal experiences. As a class, brainstorm different ways to expand positive action from a personal level to the world community.

EXTENSIONS

A. Building on the lessons of this activity, the class could develop a plan for solving solid waste and other environmental problems on a school, community, state, national, and international level.

B. Have each student select a problem about which they feel helpless, outline a positive action plan, keep a daily journal documenting their experiences, and write the results after time in essay form.

Vocabulary: environmental pollution, myopic, swath.

My Twenty Foot Swath
Kenneth V. Lundberg
Covenant Companion

"I worried so much about world hunger today, that I went home and ate five cookies." Did personal or global problems ever become so overwhelming that you were immobilized, or driven to some action that actually aggravated the problem? Have you experienced such frustration about the hopelessness of solving the problems of poverty, environmental pollution, or human suffering that you could avoid it only be deciding that you were powerless to do anything about their alleviation? This is called Responsibility Assumption Overload. Here's how I dealt with this feeling. I park my car away from my building at work. That way I get both exercise and a parking space, as everyone else competes for spots next to the entrance. My morning and late afternoon strolls take me on a stretch of lawn between the tennis courts and the soccer field, and across an occasionally used softball diamond. The lawn is twenty feet wide, more or less. Soft and green, it was originally very littered. Tennis players discard tennis ball containers (and their flip tops), worn out sweat socks, broken shoelaces and old candy bar wrappers. Soccer game spectators leave behind beer bottles and junk food cellophane.

In my early days it disgusted me, and my thoughts centered on ways of correcting the situation writing letters to the campus newspaper (no doubt totally ignored); campaigning for anti-litter regulations (who would enforce them?); organizing a "Zap-Day" cleanup (leaving 364 days of littering). All my noble efforts would have demonstrated my indignation, raised by blood pressure, and attracted attention, but they would not have changed the appearance and/or condition of the area. So, I decided to take ownership. I would be the solution. I did not tell anyone of this; it was probably against some rule or another. I decided that I would be responsible for the environmental quality of this twenty-foot swath. I did not care what other parts of the campus were like. They were someone else's problem. But each day, going from and to my car, I picked up litter.

At first, it was as much as I could conveniently carry. Then I made a game of it, limiting my picking to ten items each way. It was an exciting day when I realized I was picking faster than "they" were littering. Finally, the great day arrived when I looked back on my twenty feet of lawn-now perfectly clean.

Where did I put the litter? At first, I brought it into a waste basket in the building, or took it to the car to bring home. Then a curious thing happened. One day, large orange barrels appeared at each end of my swath. Someone in maintenance had become my silent conspirator-periodically emptying and replacing the barrels. He, too knew the wisdom of keeping a low profile about it all.

I've done this for several years now. Has general campus appearance changed? Not much! Have litterers stopped littering? No! Then if nothing has changed why bother?

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Here lies the secret. Something has changed. My twenty-foot swath and me! That five minute walk is a high spot of the day. Instead of fussing and stewing and storing up negative thoughts, I begin and end my workday in a positive mood. My perspective is brighter. I can enjoy my immediate surroundings - and myself - as I pass through a very special time space. "It" is better because of me. I am better because of "it". "We" enjoy the relationship. Maybe, even, "it" looks forward with anticipation to my coming.

My learning - and the twenty-foot swath - does not stop at the building door. There is an important principle that follows wherever I go. I cannot solve man's inhumanity to man, but I can affirm, with a smile and a word of appreciation, those who feel burdened by the need to work at lowly jobs. I cannot right the imbalances of centuries of discrimination, but I can "lift up" someone who feels the weight of a poor self-image. I can treat women as equals without solving the problems of sex discrimination. I can seek out the social and economic litter in my own "twenty-foot swath" without demanding of myself that I "clean up the whole world."

I now practice a discipline of leaving each time-space capsule of my life a little better than when I entered it. Each personal contact, each event, each room I enter becomes a small challenge. I want to leave it improved, but more important, I am responsible to myself to be improved; and thereby, maybe - just maybe - my having been there will make life better for someone else.

I am becoming more and more disenchanted and suspicious of revolutionaries, crusaders, miltants, and do-gooders. Many, if not most, seem to be more concerned about being right than being loving or effectual. The zealot, no matter how well-intentioned, often leaves a trail of wounded people while in pursuit of the cause.

Is this all too myopic - shutting one's eyes to the greater concerns? It does not need to be! I now have a twenty-foot swath. Next year it may be forty, or sixty, or eighty feet wide. Ten talents were not required of him who had been given only one. Too many people stumble by taking on causes too great for their level of discernment and discipline. They need to begin to catch the vision of the important promise, that the meek shall inherit the earth, not the indignant or frustrated.

RECYCLING PAPER POLLUTION

9-12 ● III.B.1

Concepts
Recycling saves money and resources, reduces waste and pollution, but does not eliminate pollution problems altogether.

Objective
Students will investigate methods of recycling paper and the technical problems encountered int he recycling industry, and will discuss the issues of water pollution and the treatment and disposal of toxic and solid wastes.

Method
Students will make recycled paper and test the remaining waster for sediment content pollutants.

Materials
Several different sheets (at least 9" x 12") of different types of paper (newsprint, colored newsprint, white office paper, construction paper, envelope with tape, clip etc.): See 4-6 PAPERMAKING for additional materials.

Subjects
Earth Science, Biology, Science.

Skills
Experimenting, predicting, measuring, recording and interpreting date.

Time
One class to make the paper, one class to test the water for contaminants

Resources
Tom Watson, "New inks causing concern for newspaper de-inkers", *Resource Recycling* (Nov./Dec. 1987); State Department of Health; State Department of Water Quality; Right to Know information; paper mills.

AVR Guide Resources
PARALLEL ACTIVITIES
4-6 ● III.B.2 Making Paper.

INFORMATION
I.A.5.a Paper; III.B Recycling.

RESOURCES
A.10 Vermont Businesses;
B.4 Industries;
B.6 Recycled Paper;

BACKGROUND
Recycling saves landfill space by reducing the volume of waste paper requiring disposal, and it also saves natural resources and energy. It may reduce pollution problems and transfer them to other parts of the cycle, but it does not eliminate them.

Used paper fibers must be de-inked and contaminants removed. Black printing inks used in newspapers are composed of about 30% pigment (usually carbon black) and about 70% petroleum-refined oil. Colored pigments used in magazines and increasingly in newspapers contain heavy metals. New low-rub inks and laser printing cause additional problems because they are difficult to remove from paper. The paper-making process requires large amounts of water, all of which must be cleaned of contaminants before release into the environment. The remaining paper sludge must also be disposed of properly.

LEADING QUESTION
Does recycling solve all our solid waste problems?

PROCEDURE
1. Using the procedure in Activity 4-6 ● III.B.2 MAKING PAPER, each group of students will make recycled paper out of a different type of waste paper. They will save the water used and test it for toxicity.

2. Students might also measure volumes and weights of waste paper before and after the recycling process by filtering the remaining water and letting the sludge dry. Students could also compare the fiber content (length of fibers) of paper made from virgin fibers, recycled appear, and paper-making residue.

3. Discuss the results. Should the remaining paper sludge be treated as solid waste or hazardous waste? How can we reduce pollution problems?

EVALUATION
What problems are encountered in the making of recycled paper?
Does recycling eliminate pollution problems?
Despite any problems, is recycling paper on balance better environmentally than making paper from virgin wood? Why?

EXTENSIONS
A. Visit a paper-making plant.

B. Research the pollution control methods used in paper making plants.

Vocabulary: pollution, de-inking, recycling.

HOW CAN WE RECYCLE OUR RESOURCES?

COLLECTING AND SORTING 9-12 ● III.B.2

Concept
Designing an efficient system for handling recyclables will enhance the success of any recycling project.

Objective
Students will understand some of the design considerations of establishing a recycling facility, and will use this information to design a hypothetical recycling center for their town or school.

Method
Students will design and make scale drawings of hypothetical recycling facilities in their community.

Materials
Paper, pencils, presentation materials, rulers, population figures local maps.

Subjects
Social Studies, Industrial Arts, Art, Living Arts.

Skills
Brainstorming, designing, hypothesizing, inferring, observing, problem solving, recording and interpreting data.

Time
One week.

Resources
Local governments, local waste haulers, local recycling groups and businesses.

AVR Guide Resources

PARALLEL ACTIVITIES

K-3 ● III.B.2 What's Recyclable?;
4-6 ● III.B.3 Where to Recycle;
7-8 ● III.B.1 Source Separating.

INFORMATION

II.A. Transportation and Processing;
III.B Recycling.

RESOURCES

A.7 Places to Recycle;
A.9 Recycling Business;
C.5 Recycling.

BACKGROUND
There are several options for the collection and processing of recyclables.

- Drives are one-shot collections usually organized for one material and requiring little ongoing processing or storage if organized well.
- In curbside collection programs, each household separates its recyclables from the trash, prepares them for recycling, and the trash hauler or recycler picks the separated materials up with the trash.
- Mixed recyclables can be collected, with separation occurring at the processing facility.
- Citizens can drop off their recyclables at bins, sheds, or boxes located in the community for easy access and unsupervised collection.
- Automated collection of beverage containers occurs at reverse vending machines which operate similarly to soda vending machines. Containers are inserted and money is dispensed.
- Buy-back centers will exchange payment for materials delivered.

LEADING QUESTION
What kind of recycling program would be best for our town for our school?

PROCEDURE
1. Have students collect information on local waste and recycling practices to determine needs for recycling. Consider the amounts of waste and recyclable generated, markets, funding sources, storage spaces, community support available, etc.

2. Invite a local recycler, town official planner from your solid waste district or regional planning commission to talk to the class and/or visit a recycling center.

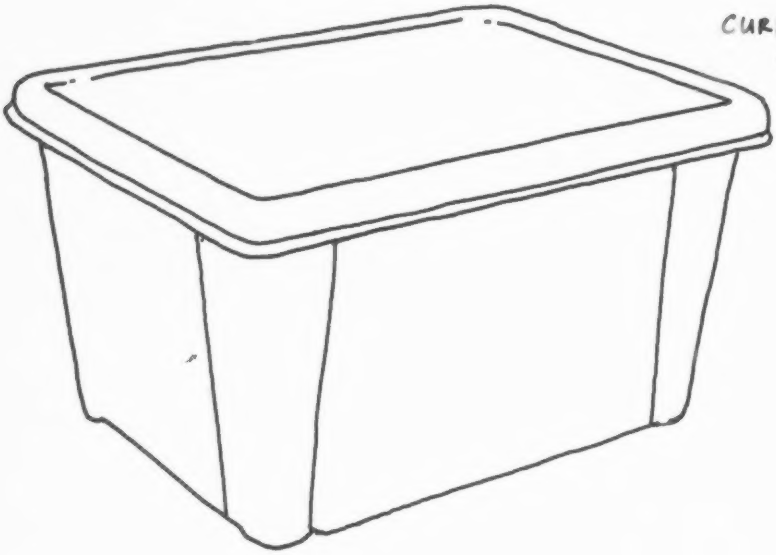
3. Using this information, decide as a class on the best type of activity (buy-back, curbside, etc.) for the town. Once this decision is reached, proceed to design a program for storage, collection, processing etc. of the recyclable(s) to be handled. Design a facility the town or school could use.

EVALUATION
Students should be able to identify the major considerations in designing a recycling program, and should be familiar with the waste management picture in their area.

EXTENSIONS
A. Present information and plans to town official and local planning groups.

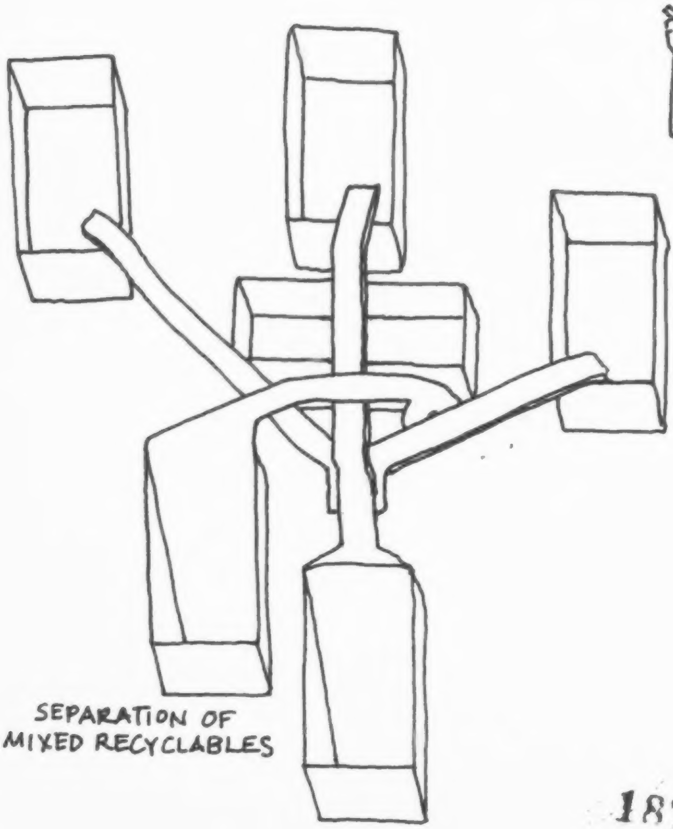
B. Visit other recycling facilities, find out how they started, operate, etc.

Vocabulary: recycling, sorting, collecting, buy-back, curbside collection, reverse vending machines.

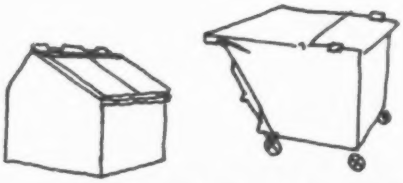


CURBSIDE CONTAINERS

EAGER BEAVER



SEPARATION OF MIXED RECYCLABLES



BINS and DUMPSTERS

SPEAKING FOR RECYCLING

9-12 ● III.B.3

Concept
Communicating a knowledge of recycling to an audience.

Objective
Students will become more familiar with recycling and solid waste management issues and will develop their public presentation skills.

Method
Students will present an informational speech relating to recycling.

Materials
Research materials, note cards.

Subjects
English, Speech, Social Studies, Science.

Skills
Researching, organizing data, writing, public speaking.

Time
One class period plus library time.

Source
A Way With Waste.

AVR Guide Resources
INFORMATION
All of the Information Section.

RESOURCES
A.7 Places to Recycle;
A.8 Volunteer Recycling Groups;
A.9 Recycling Businesses;
B.3 State Recycling Associations;
C.5 Recycling.

LEADING QUESTION
What do we need to know about recycling?

PROCEDURE
Students will:

1) research some aspect of recycling or solid waste management,
2) using collected information, students will write a speech outline that includes an introduction, supporting evidence, and conclusion.
3) put the supporting material on notecards, and
4) practice delivering the speech to the class or another group.

Topics might include:

-Why home source separation is easy.
-How does an Eager-Beaver Trailer (or other recycling equipment) work?
-What are plastic soda bottles (or any other recyclable material) made into?
-How does composting work?
-What are the benefits of recycling to society? The drawbacks?
-How recycling could work/does work in our Town.
-What economic problems work against recycling?
-What changes in society, in national policy would promote recycling?

EVALUATION
Students will be evaluated on the quality of research, depth of information presented, delivery of speech and class reaction.

EXTENSIONS

A. Focus on specific recycling topics such as aluminum, glass, etc.

B. Present speech to other groups: (i.e. community groups, school board, town officials, service groups, etc.)

C. Attend various public hearings and evaluate information.

D. Develop an informational speech into a "persuasive" speech. (Persuasive topics might include: "Recycling should be mandatory in our Town." "Non-recyclable beverage containers should be banned by the State." "Recycling should not be mandatory until it is cheaper than landfilling waste.")

E. Look at the logo and slogan samples on the following page and create your own recycling logo for you town or school.

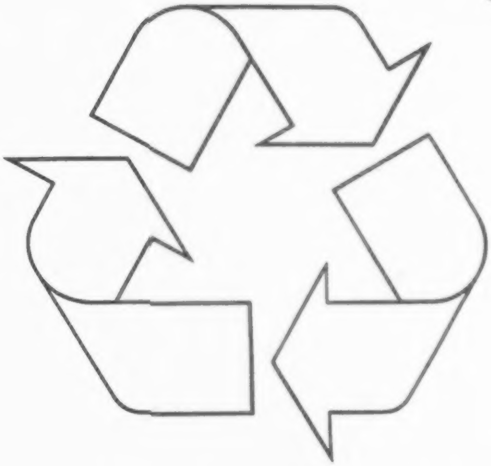
Vocabulary: recycling.

SPEAKING FOR RECYCLING 9-12 ● III.B.3

Name:

Date:

RECYCLE
Give Your Trash a Second Chance



I'VE COME AROUND • I RECYCLE •

Give your trash a second chance. Recycle.

Give a bottle a decent break. Recycle.

Save a can from a life on the street. Recycle.

Turn your old paper into good news. Recycle.

Give your dirty oil a clean start. Recycle.

Send your leaves to a mulch better place. Recycle.

THE CART BEFORE THE HORSE?

9-12 ● III.B.4

Concept

We need to redesign laws and revise habits in order for recycling to work.

Objective

Students will consider ways to reduce waste in the United States.

Method

Students will listen to quotes, read the National Recycling Coalition's pamphlet, and discuss ways to reduce waste and increase recycling.

Materials

Copies of National Recycling Coalition pamphlet (Information III.A.2) for each student.

Subjects

Social Studies, Economics.

Skills

Reading, analyzing, brainstorming, values clarification.

Time

One class period.

Sources

National Recycling Coalition; Cynthia Pollack, Worldwatch Paper #76; Phoenix Quarterly.

Resources

Local recycling groups (A.8), solid waste districts (A.3), ANR (A.1).

AVR Guide Resources

ACTIVITIES

4-6 ● III.B.3 Where to Recycle;
7-8 ● III.B.2 Graphing Recyclable.

INFORMATION

II.C Public Planning and Policy;
III.A Redesign and Reuse;
III.B Recycling.

RESOURCES

B.4 Industry Associations;
B.5 Environmental Groups;
C.5 Recycling.

BACKGROUND

An inventory of the world's discards would reveal metals more valuable than the richest ores, paper representing millions of hectares of forests, and plastics incorporating highly refined petrochemicals. That these produces rich in raw materials and concentrated energy are frequently considered worthless is indicative of a distorted economic system. We are literally throwing away our future.

- Cynthia Pollock, 1987.

We do not buy scrap out of altruism or patriotism. Neither do we buy it just because it saves energy or is good for the environment. It's nice if those benefits follow along but we don't have much patience with those who not only advocate, but would legislate, putting the cart before the horse.

- J.J. Ferrigan, Bethlehem Steel. (Phoenix Quarterly, Fall 1981.)

A city the size of San Francisco disposes of more aluminum than is produced by a small bauxite mine, more copper than a medium copper mine and more paper than a good sized timber stand. San Francisco is a mine.

-- David Morris (Worldwatch Paper #76)

LEADING QUESTION

Why isn't everybody recycling?

PROCEDURE

1. Discuss the background quotes. If recycling saves energy and resources, saves landfill space, reduces pollution, etc., why doesn't it seem to be economically feasible? Does business pay the full costs of producing, transporting and disposing of its products? What are these costs and if not business, who does pay them?

2. Students read the National Recycling Coaliton pamphlet and answer questions on worksheet.

EVALUATION

Worksheet.

EXTENSIONS

A. Develop a flow chart tracing all the costs of an object from extraction of a raw resource to disposal. Include environmental costs and subsidized costs. What would happen if the manufacturer were forced to pay the hidden costs? Why isn't this the case?

B. Choose one recyclable. Check several different markets and haulers to see what prices, if any, are being offered for the material. What prices are they being paid for the materials by the end-user?

C. Write an essay defending or refuting any of the three given quotes.

Vocabulary: policy, redesign, secondary recycled materials, tax advantages, economic competition.

A National Recycling Policy?

1. What reasons does the NRC give for pursuing recycling as a "necessity?"

2. Why do "secondary recycled materials" have difficulty competing with virgin materials?

3. What policies does NRC suggest to help "secondary recycled materials" compete?

4. What could a "national recycling data base" be used for?

5. What does the NRC mean by "Design for Recyclability?"

6. What principles does the NRC suggest that a national recycling education policy should emphasize?

7. What six specific recommendations does it make for its national policy for recycling education?

8. Do you agree with these recommendations? What other measures do you think would help recycling?

HOW CAN WE RECYCLE ORGANIC WASTE?

MICROORGANISMS

9-12 ● III.C.1

Concept
Microorganisms are essential to the recycling of organic matter.

Objective
Students will relate the importance of healthy microorganisms activity to composting.

Method
Students will view slide samples under the microscope and sketch observations.

Materials
Two trays, soil, 12 slides, water, containers, violet, or methyl blue, eosine, microscopes, wax pencil.

Subjects
Science, biology.

Skills
Experimenting, observing.

Time
Three weeks.

Sources
Oscar's Options; Daniel J. Dindal, S.U.N.Y College of Environmental Science & Forestry.

Resources
Cecil E. Johnson, "Wild World of Compost" *National Geographic* (August, 1980.) Mary Appelhof, *Worms Eat My Garbage* .

AVR Guide Resources
PARALLEL ACTIVITIES
K-3 ● III.C.1 Banana Peel Blues;
4-6 ● III.C.1 Mini Compost;
7-8 ● III.C.1 Making Good Compost;
9-12 ● III.C.2 Effective Fertilizers.

INFORMATION
III.C Compost.

RESOURCES
C.6 Composting.

LEADING QUESTION
Can you identify microorganisms responsible for the composting process?

PROCEDURE
1. Fill a tray with dry soil. Fill another with soil plus 5-10% organic matter, will mixed. Insert six slides vertically into each container, as in Figure 1.

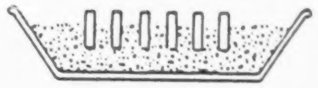


Figure 1

2. Six slides in each container will permit observation of each sample at the end of one, two and three weeks. Each observation requires two slides, one stained dark and one stained light. Adjust the moisture content to about 20% water by adding a volume of water corresponding to about 1/5 of the volume of soil. Keep moisture content as constant as possible by adding water as needed.

3. After one week, two slides from each container will be studied according to the following procedure. Dig soil away from one side of the slide, then tilt the same slide toward the hole and lift it out as in figure 2.

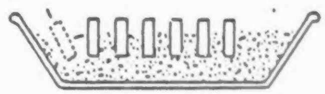
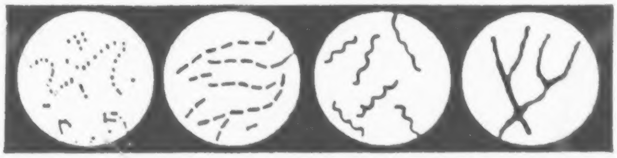


Figure 2

4. The slide will now have a film of soil and microorganisms on one side. Clean the other side with a cloth. Label the slide with a wax pencil and prepare a second slide in the same way.

5. The preparation on the slide is "fixed" by passing the slide over a flame - one or two passes should be sufficient. Stain one slide dark, using gentian violet or methylene blue. Stain the other slide light, with eosine.

6. Examine each slide for the presence of bacteria with the low and high powers of a microscope. If present, spirilla will probably not be seen unless the field is darker. Sketch the observations and have students compare them to Figure 3 in order to identify themorphological class of the bacteria.


Cocci. Bacilli Spirilla Actinomycetes
Figure 3: Common Morphological Classes of Bacteria

Vocabulary: microorganisms, compost.

PROCEDURES (continued)

7. Have students determine whether there are differences in the number the types of microorganisms in the two samples.

8. At the end of the second week, repeat the procedures with another pair of slide from each sample. Have students determine if the number and types of bacteria in the samples have changed significantly and help them to account for the changes.

9. At the end of the third week, repeat the procedures and make further observations. Have students relate their observations and conclusions to composting.

EVALUATION

Number of samples found.

EXTENSIONS

A. Share the food web of compost pile with students. Discuss its ramifications on composting and, if possible, assemble some of the consumers for direct observation.

B. Culture samples on nutrient agar in petri dishes. Observe what grows.

C. Grow a mold garden.

HOW CAN WE RECYCLE ORGANIC WASTES?

EFFECTIVE FERTILIZERS

9-12 ● III.C.2

Concept
Organic and mineral wastes can be recycled into effective fertilizer.

Objective
Students will rate the effectiveness of various organic and inorganic fertilizers.

Method
Students will test growth rates of different plants.

Materials
6 bean seedlings ready for transplanting and six pots per student or group of students; stock amounts and solutions of some or all of the following: manure, fish fertilizer, algae, rabbit "tea" -a bag of rabbit manure and water mixed, potting soil, any balanced organic fertilizer.

Subjects
Biology, Science, Horticulture.

Skills
Experimenting, describing and comparing, formulating questions, hypothesizing, inferring, recording and interpreting data.

Time
Three weeks for seeds to germinate, four weeks experiment.

Sources
A Way With Waste, Connections.

Resources
Robert Rodale, Ed., *The Basic Book of Organic Gardening;* Catharine Foster, *The Organic Gardener*, National Gardening Association.

AVR Guide Resources
PARALLEL ACTIVITIES

K-3 ● III.C.1 Banana Peel Blues;
4-6 ● III.C.1 Mini Compost;
7-8 ● III.C.1 Making Good Compost;
9-12 ● III.C.1 Micro-Organisms.

INFORMATION

III.C Compost.

RESOURCES

C.6 Composting.

BACKGROUND
Some common fertilizers: **BONE MEAL** is a powdered, crushed bone. It can be sprinkled around growing plants. **BLOOD MEAL** is dried, powdered blood. It has a high nitrogen content and should be used sparingly. **FISH EMULSION** is liquid fertilizer made from fish. It is a good source of both nitrogen and phosphorus and should be diluted in water before pouring around plants. **GRANITE DUST** is powdered granite and a good source of potash. It can be mixed with soil or added on the side. **ROCK PHOSPHATE** is a powdered rock rich in phosphorous, calcium, iron, sodium, magnesium, boron and iodine which can be mixed with soil or added on the side.

LEADING QUESTION
What are fertilizers made of?

PROCEDURE
1. Germinate bean seeds by soaking overnight and planting in soil 2-3 cm. deep. Keep warm and moist. After three weeks, pick plants of equal health for fertilizing and transfer to individual pots.

2. Have students state hypotheses about the effect of different fertilizers on plant growth. Discuss the nutrients in each fertilizer. Emphasize the recycled origin of most of these fertilizers. Discuss solubility and residuality of fertilizers. Discuss measurement of growth (height, number and color of leaves, roots, etc.)

OPTION: Number fertilizers: don't tell students which plant corresponds with which fertilizer. This will make the experiment exciting and more valid.

3. Add recommended doses of fertilizer and maintain one control group of six. Have students water all plants at the same time, with the same amount. Record results once each week for four weeks. Have class compile results after one month. Discuss accuracy of class results vs. individual results. Determine rating scheme and reveal the winner. Discuss what other recycled materials could be used for fertilizer.

EVALUATION
Name three kinds of fertilizers suitable for growing beans from seed. Which would you choose? Why? What are fertilizers made of? How is fertilizing a form of recycling? What does "organic" mean?

Vocabulary: composting, fertilizer, bloodmeal, phosphate, organic, solubility, residuality.

INFORMATION SECTION CONTENTS

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  - 1. Vermont Solid Waste (chart)
  - 2. Residential Garbage Sort 1986 (chart)
  - 3. National Waste Stream (chart)
  - 4. International Waste Generation (chart)
  - 5. Components of the Waste Stream (a. Paper b. Glass c. Metals d. Rubber e. Plastic)
  - 6. Hazardous Materials (a. Household Toxics b. Waste Oil c. Batteries)
  - 7. Packaging
- **B. WASTE AND NATURAL RESOURCES**
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  - 2. Natural and man-made cycles (illus.) (See also I.A.5 above)
- **C. WASTE AND SOCIETY**
  - 1. A Very Short History of Trash
  - 2. Trash Timeline

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  - 1. Vermont Solid Waste ACT 78 Summary
  - 2. Vermont Solid Waste Plan Summary
  - 3. Vermont Bottle Bill
  - 4. Vermont Fact Sheet
  - 5. International Perspectives

III. REDUCING WASTE

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  - 2. Reuse Ideas
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  - 2. Recyclables (illus.)
  - 3. How to Recycle
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- **C. COMPOSTING**
  - 1. Composting Overview
  - 2. Municipal Leaf Composting
  - 3. Backyard Composting

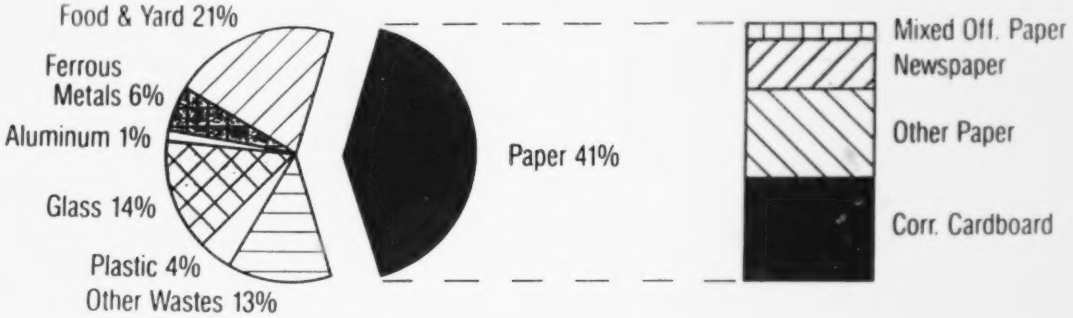
GLOSSARY

Metric Conversions

Mixed Solid Waste Composition

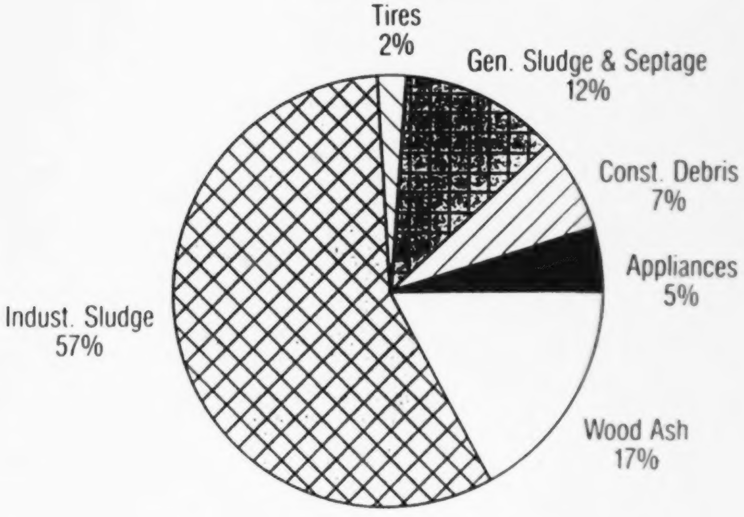
State Total, 1987
328,200 Tons

% by weight of waste generation.
Excludes special wastes.



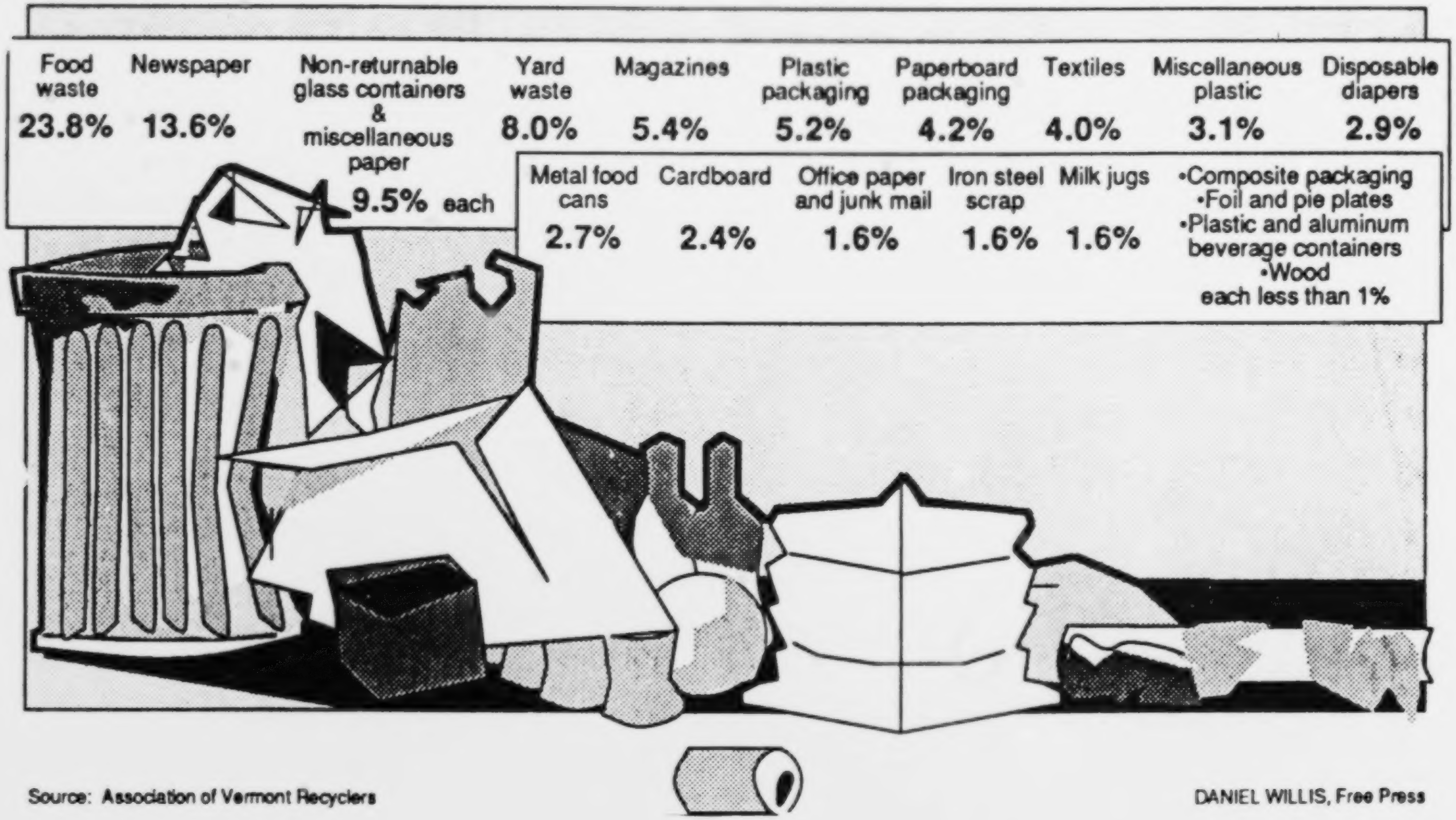
Special Solid Waste Composition

State Total, 1987
135,500 Tons



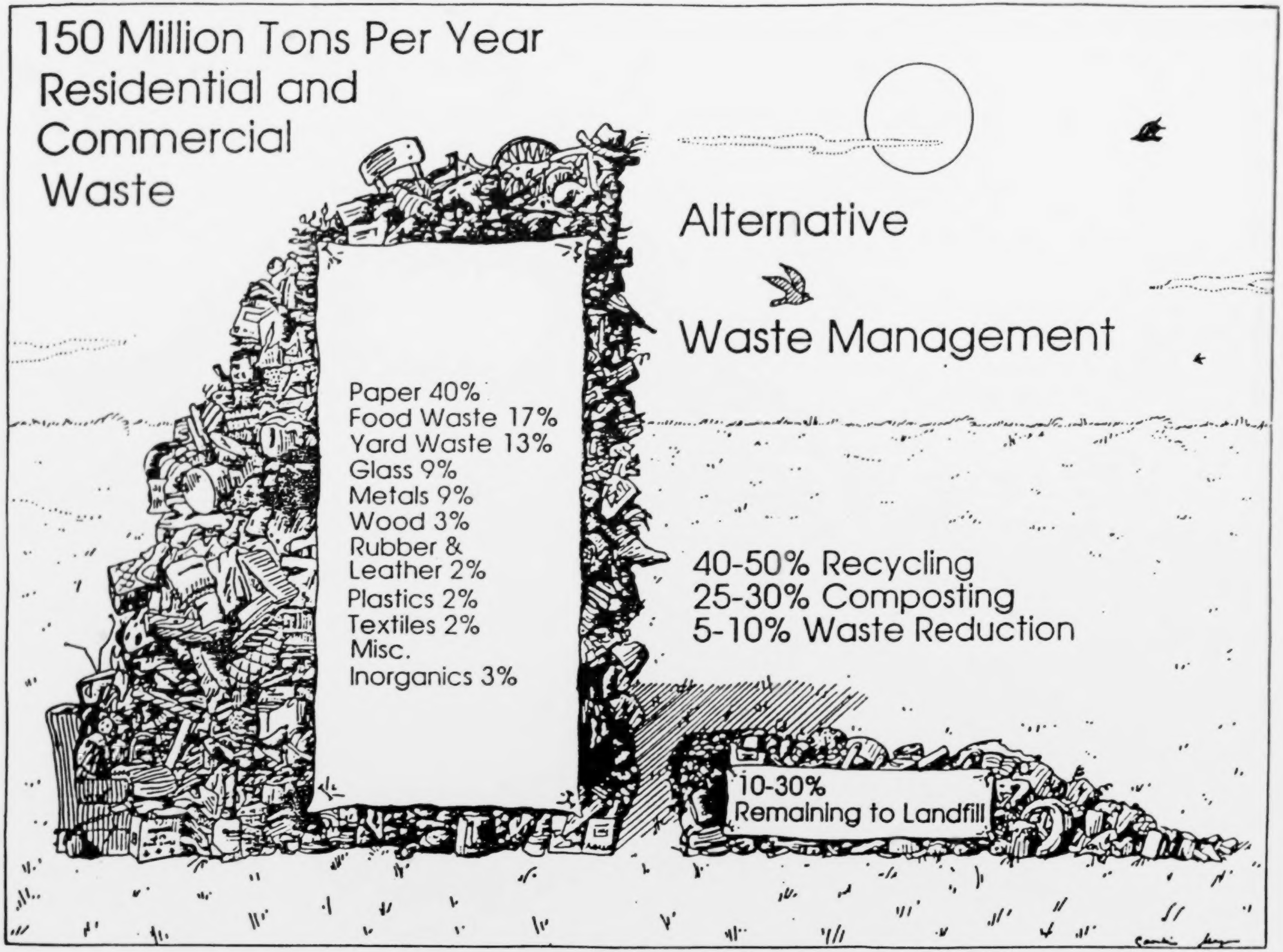
Source: State of Vermont Solid Waste Plan

The breakdown of an 800-pound sample of residential garbage:



Source: Association of Vermont Recyclers

DANIEL WILLIS, Free Press



150 Million Tons Per Year Residential and Commercial Waste

Paper 40%
Food Waste 17%
Yard Waste 13%
Glass 9%
Metals 9%
Wood 3%
Rubber & Leather 2%
Plastics 2%
Textiles 2%
Misc. Inorganics 3%

Alternative Waste Management

40-50% Recycling
25-30% Composting
5-10% Waste Reduction

10-30% Remaining to Landfill

From RESOURCES, now a part of *Environmental Action* magazine

Table 20.7 Waste Generation in Selected Countries, 1975–86

	Average Annual Municipal Waste Generation						Industrial Waste Generation				Hazardous and Special Waste Generation	
	Total (thousand metric tons per year)				Per Capita[b]	Per Unit Area (metric tons per km² per year)	Year of Estimate	Total (thousand metric tons per year)	Per Million $US of Industrial Gross Domestic Product[c] (metric tons)	Per Unit Area (metric tons per km² per year)	Total (thousand metric tons per year)	Per Unit Area (metric tons per km² per year)
	1975	1980	1983	1984/85[a]	(kg)							
AMERICAS												
Canada	X	12,600	16,000	X	642	1.7	1980	61,000	730	6.6	3,290	0.4
Costa Rica	X	X	534	X	211	10.5	X	X	X	X	X	X
Mexico	X	X	X	32	0	0.0	1986	192	3	0.1	X	X
United States	140,000	160,000	178,000	X	744	19.4	1985	613,000	501	66.9	250,000	27.3
ASIA												
Cyprus	X	X	X	X	X	X	1985	56	X	6.2	X	X
Israel	X	X	X	1,400	330	65.1	X	X	X	X	30	1.4
Japan	38,074	41,511	41,095	X	342	110.8	1983	220,548	494	594.5	768	2.1
Korea, Rep	X	X	15,746	X	679	160.7	1981	7,030	274	71.7	180	X
Singapore	X	1,082	X	1,498	X	2,496.7	X	X	X	X	X	X
EUROPE												
Austria	1,407	1,560	1,630	X	216	19.4	1983	5,110	197	60.8	100	1.2
Belgium	2,900	3,082	X	X	X	205.2	1980	8,000	196	242.4	915	27.7
Bulgaria	X	X	X	6,773	757	0.6	X	X	X	X	X	X
Czechoslovakia	X	X	X	X	X	X	1982	80,910	X	647.3	X	X
Denmark	X	2,046	X	X	399	48.7	1980	814	X	19.4	90	2.1
Finland	X	X	1,200	X	247	3.9	1984	14,000	804	45.9	124	0.4
France	X	14,000	X	X	260	25.6	1980	32,200	137	59.0	2,000	3.7
Germany, Fed Rep	20,423	21,417	20,268	27,544	447	112.9	1982	52,464	172	215.0	4,900	20.1
Greece	X	X	2,500	X	259	19.1	X	X	X	X	X	X
Hungary	X	X	X	7,000	658	76.1	1985	21,146	2,509	229.8	7,081	77.0
Iceland	X	X	X	93	388	0.9	1985	105	X	1.1	X	X
Ireland	555	640	1,100	1,270	359	15.9	1984	1,580	346	22.9	20	0.3
Italy	14,095	14,041	X	X	249	47.8	1980	35,000	207	119.0	2,000	6.8
Luxembourg	X	X	X	190	514	76.0	1985	95	X	38.0	15	6.0
Netherlands	X	7,450	7,180	7,242	500	213.0	1984	4,137	97	121.7	280	8.2
Norway	X	2,200	X	1,700	280	7.1	1980	2,186	93	[illegible]	120	0.4
Poland	X	X	X	7,900	212	25.9	1985	274,885	X	901.3	X	X
Portugal	X	1,300	1,700	2,246	233	24.4	1980	11,200	1,110	121.7	1,049	11.4
Spain	X	8,028	X	10,600	275	21.2	1985	1,500	X	3.0	X	X
Sweden	2,400	2,500	X	X	301	6.1	1980	4,000	102	9.7	550	1.3
Switzerland	1,600	2,146	X	X	336	53.7	X	X	X	X	100	2.5
United Kingdom	16,036	15,816	16,398	X	291	67.8	1984	50,000	327	206.6	1,500	6.2
USSR	X	X	X	X	X	X	1985	306,258	X	13.8	X	X
OCEANIA												
Australia	X	10,000	X	X	681	1.3	1980	20,000	X	2.6	300	0.0
New Zealand	1,150	1,528	2,106	1,160	653	4.3	1982	300	38	1.1	45	0.2

Sources: Organisation for Economic Co-operation and Development; United Nations; and national sources.

Notes:

a. Refers either to 1984 or 1985.
b. Figures are for most recent year available.
c. The portion of Gross Domestic Product contributed by industry.
For additional information, see Sources and Technical Notes.
X = not available.

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The History of Paper

The first paper was made about 300 million years ago by wasps. Wasps chew wood into a pulp and use the paste to make the walls of their houses. Humans began experimenting with paper-like substances only a few thousand years ago in an effort to find a more convenient writing and drawing surface than stone.

Animal skins were cleaned and pounded and stretched to make parchment. The inner bark from trees was peeled and pounded into thin sheets, and silk, woven into fabric, was also used as a painting surface. Papyrus reeds were also layered and pounded together to form lightweight sheets.

Paper gets its name from papyrus, but the two are made quite differently, though they both contain the key element of cellulose. Cellulose is the major building block of all plant cell walls. To make papyrus, whole plants were layered and pounded together. To produce a sheet of paper, cellulose is broken down into individual fibers by beating them and mixing them with water. The water is then drained away, leaving an interwoven mass of fibers in a thin sheet.

The first real paper was probably made by the Chinese in 105 AD out of mulberry tree bark, hemp, fishnets, and rags. The first European paper mill was built in Xativa, Spain in 1151 AD. The use of linen and cotton rags for making paper became commonplace in Europe.

Paper was made by hand by dipping screens into large vats of paper pulp and drawing out and draining a thin sheet of fibers. In 1799, the Fourdrinier brothers patented a machine which produced an endless roll of paper automatically. The paper-making machinery used today is basically the same as what was developed two centuries ago.

About the same time that the Fourdriniers were developing their machine, Matthew Lyon of Fair Haven, Vermont had developed a method for making paper, not from used clothing fibers, but from the bark of the bass-wood tree and saw dust. Today most of the paper we use comes from trees, and the United States has become the largest producer and consumer of paper and paper products in the world.

From what Natural Resources is Paper made?

Wood that is unsuitable for use as lumber and lumber mill wastes are used to manufacture paper. The equivalent of 17 trees are used to produce one ton of paper. Most of this fiber comes from fir and pine forests of the northwest and pine forests of the south and southeast. Hardwood forests of the North Central U.S. and New England are also used. 3,688 pounds of wood, 28,000,000,000 BTU's of energy, 216 pounds of lime, 76 pounds of soda ash, 360 pounds of salt cake, and 24,000 gallons of water are used to make just one ton of paper.

How is Paper made Commercially from Trees?

To save transportation costs, paper mills are usually located near the forests where the wood is harvested. The trees are debarked, chipped, mixed with chemicals and processed in a large steam-heated pressure cooker called a digester. This helps to break the wood down into cellulose fibers. The fibers are then rinsed with water to remove chemicals, unwanted wood contaminants and dirt.

The remaining water-wood mixture, called slurry, is fed onto a screen and shaken to intermesh the cellulose fibers. Water is drained through the screen and the remaining sheet of paper passes through a series of rollers where it is pressed and dried. The continuous rolls of paper are produced by the machine at a rate of 30 feet per second and can be 16 feet wide.

What Effects does Paper Manufacture have on Our Environment?

About 35% of the world's annual commercial wood harvest is used to produce paper, and this share is expected to grow to 50% by the year 2000. Although wood is a renewable resource, we are presently using more of our forest resources than we are replacing. U.S. Government subsidy of lumbering activity keeps the cost of wood products artificially low, encouraging their continued depletion.

In addition to depleting natural resources, manufacturing paper pollutes the environment. According to one estimate, producing one ton of paper creates 84 pounds of air pollutants, 36 pounds of water pollutants, and 176 pounds of solid waste. Disposing of used paper pollutes again, as litter, air pollution from burning, or ground water contamination from leachate.

What do We Use Paper for?

Paper is used for three main purposes: 1) as a lightweight, durable surface for writing and printing, 2) to wrap and package food and other items, and 3) for sanitary products such as paper towels and tissue. In 1984, the United States consumed 78 million tons of paper and paperboard products. Of this amount, 43.9 million tons were thrown away, using up more landfill space than any other human-made trash.

Why Recycle Paper?

If we recycled half of the paper used in the world today we would meet almost three-quarters of the demand for new paper and as a result might arguably free ten million acres of forest from harvest destined for the paper industry. As it stands, we waste about three-quarters of our used paper resources.

According to one estimate (which likely does not assess materials transportation and processing effects), when paper is made from waste paper instead of trees, 60% less water and 70% less energy are used, and 50% less pollutants are added to the environment.

Recycling also helps extend the life of our landfills. Nearly a third of our waste stream by weight and over half by volume is made up of paper. Recycling one ton of this waste saves an average of three cubic yards of landfill space.

How is Paper Recycled?

Waste paper must be sorted prior to recycling to ensure the best quality end product and to eliminate inks and adhesives which can damage machinery. Care must also be taken to store it out of sunlight and away from water which can break down cellulose fibers and make the paper unusable.

At recycling centers, paper is baled for shipping and transported to one of over 600 paper mills in the United States. At the mill, bales of waste paper are dumped into a pulper where a rotor mixes it with warm water and breaks the cellulose fibers back down into slurry. Plastic, wax, non-water soluble glue, carbon and similar substances which have not been removed in initial sorting will clog rotor sieves.

Once the rotor has thoroughly mixed the paper-water solution, a sieve catches contaminants such as paper clips and staples. The mixture then travels on through centrifugal cleaning tanks and is bleached and deinked. Chemical de-inking can contribute to increased water pollution problems, as can loss of short paper fibers through screens.

Once cleaned, the slurry is deposited on screens, sent through rollers, and formed into the finished sheets of recycled paper in much the same way the original paper was made.

What is Recycled Paper Used for?

Waste newspaper can be shredded and re-used as animal bedding or packing material. Or it can be shredded, defibered and treated with fire-resistant chemicals for use as building insulation.

Waste paper is usually recycled into a lower grade product than the original, as wood fibers break-up and deteriorate. Hence, unlike aluminum and glass, a given quantity of wood fiber cannot be recycled perpetually. The following products are often made from recycled fibers: writing and printing paper and newsprint; roofing felt, insulation board, fiberboard, other construction materials; fruit trays, flower pots, egg cartons and other products molded from paper pulp; kraft paper, tissue, corrugated cardboard and cardboard boxes.

Is Recycled Paper as Good as Paper from Virgin Fibers?

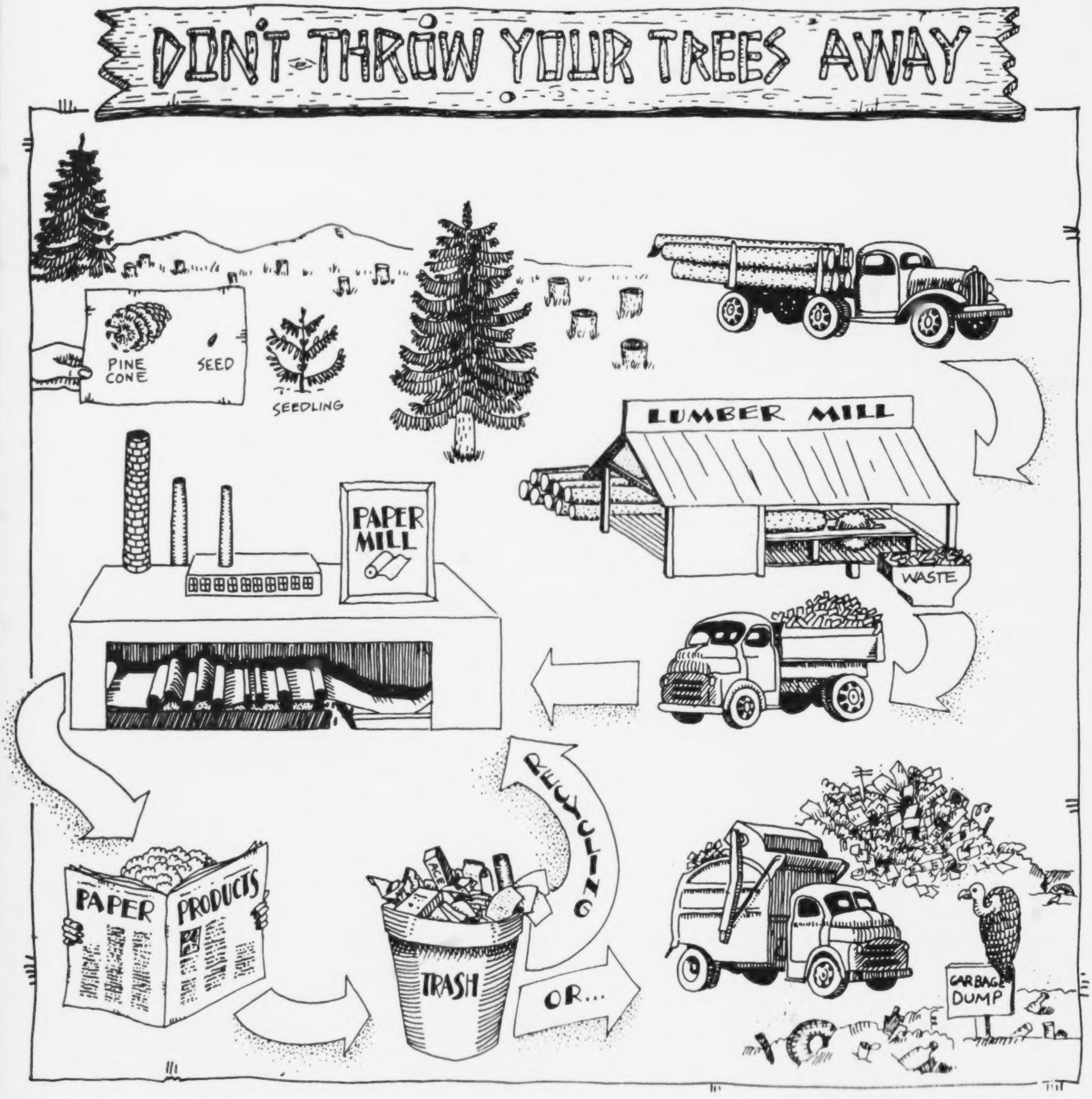
Some people think the quality of recycled paper is not as high as paper made from virgin materials. Printers cite problems with lint from short broken fibers causing a poor quality print, and a high moisture content causing paper-feeding problems. But according to Earth Care Paper Company, recycled paper is superior to paper made from virgin fibers because the fibers are more conditioned, the paper has greater flexibility, stands up better to humidity and temperature changes, has greater opacity, holds clay better, and is easier to feed on printing presses than non-recycled papers.

A Recycling Outlook

Recycling businesses operate in a hostile economic and political environment. Paper manufacturers often make product and packaging development decisions without regard to waste disposal and environmental costs and concerns. Freight taxes are lower for virgin materials than for recycled fiber. The forest industry is heavily subsidized through government tax policies and leasing of public land below cost to loggers. These artificial structures hide the real economic and environmental costs of using virgin material.

Of the 600 paper mills in the U.S., over 200 use recycled fibers exclusively and another 300 use some recycled fibers. The U.S. has also been exporting an increasing amount to other countries; between 1970 and 1986, exports of waste paper rose from 408,000 tons to 3,749,000 tons.

Sources: American Paper Institute; RE:SOURCES, Summer 1986; Grummer, 1980; Earth Care Paper Company; State of Vermont Solid Waste Management Plan, 1988; Seymour and Girardet, 1987; Pollack, 1987; Chandler, 1984.



National Center for Appropriate Technology, Sophie Dven, illustrator.

History of Glass

Three to four thousand years ago, Egyptians and Mesopotamians were using opaque glass as a glazing for pots and to make beads and small bottles. The technique of glass blowing produced the first transparent glass and was developed in Syria several hundred years later. The art of glassmaking spread to the Roman Empire and then throughout Europe in the following centuries, becoming a widespread and highly crafted art form. The first known established glass house in America was founded in 1739 in New Jersey. Early glass factories in America mostly produced simple useful glass objects such as window panes and bottles. The production of glass was not automated until the mid-nineteenth century.

From What Raw Materials is Glass Made?

1,330 pounds of sand, 433 pounds of soda ash, 433 pounds of limestone, 151 pounds of feldspar, and 15.2 million BTU's of energy are required to produce just one ton of glass. Major deposits of white sand suitable for making glass are found in Illinois, New Jersey, the Alleghenies, and the Mississippi valley. Most soda ash comes from Wyoming, and 65% of the feldspar in the U.S. comes from California and North Carolina.

Soda ash (sodium carbonate) and cullet (recycled glass) are added to lower the melting point of silica and to create a good consistency. Limestone (calcium carbonate) is added to stabilize the mixture and keep it from dissolving in water. Different colored glass is produced by adding small amounts of other substances such as iron, copper and cobalt. Green glass, for instance, is made by adding iron.

How are Glass Containers Made?

The entire mixture of ingredients used to make glass is called a batch. The batch is heated at temperatures reaching 2800 degrees F until the ingredients are completely melted and the mixture transparent. The batch is then cooled to about 1800 degrees F and the molten glass moved out of the furnace into a glass-forming machine which presses or blows it into its final shape.

In the glass-forming machine, compressed air pushes a gob of molten glass down into a mold. More compressed air is forced into the middle of the mold pushing the glass out against its walls. The container is then transferred to another mold where one last blast of compressed air forms the rough container into its final shape. Finally, the containers are passed through a tunnel called an annealing lehr. If glass containers cool too quickly, they may shatter; annealing prevents breakage by passing the newly-formed containers through a tunnel which reheats the glass and allows it too cool slowly.

How Much Glass do We Produce?

There are currently 90 glass bottle manufacturers in the United States making over 29 billion bottles a year. Each person in the United States uses almost 400 bottles and jars annually. However, glass production for beverage containers is decreasing as plastics become more popular. Another change is that refillable glass beer and soda bottles which were once designed to handle up to 30 round trips from manufacturer to consumer have become throwaway containers. This means that all the energy and raw materials used to produce the glass bottle are wasted, unless recycled.

We can conserve resources by reusing glass at home, and industries would save energy by cleaning and refilling bottles, although this would be partially offset by the energy required for transporting returned bottles. The next best thing after reusing glass is recycling. In 1981, only one in fifteen of the 46 billion bottles and jars produced was melted down along with fresh material to make new bottles and jars. Bottle bill legislation has recently substantially increased the amount of recycling of glass containers. In Vermont it is estimated that almost nine out of every ten glass bottles covered by the bottle bill is returned and reused or recycled.

Why Recycle Glass?

Although the raw materials from which glass is made are plentiful, their collection and transformation into glass require a large amount of energy. It takes about 7,600 BTU's of energy to produce just one pound of glass. Also created in the production of just one ton of glass are about 385 pounds of mining waste and 28 pounds of air pollutants.

Using cullet saves energy because it melts at lower temperatures. For each 10% of cullet used, the furnace temperature can be lowered 10 degrees and the batch can be up to 83% recycled glass. Using one ton of recycled glass will save 1.2 tons of raw materials. According to one estimate, by using 50% recycled glass in manufacturing new glass, water consumption can be cut in half, mining wastes cut by 79 percent and air emissions reduced by 14 percent.

How is Glass Recycled?

To prepare glass for recycling, containers should be rinsed clean of any organic waste, aluminum and plastic caps and lead wrapping removed, and separated by color. Window glass, ceramics, pyrex, lightbulbs, mirrors and other non-container glass should never be included because the different chemical compositions will cause visual inconsistencies and structural imperfections in new glass.

Once collected and separated into green, brown and clear colors, glass is broken into very small pieces called cullet. The cullet is sorted to remove remaining contaminants such as metal and plastic caps, lids and rings. Organic waste, ceramics, dirt and rocks must be removed because they can cause flaws and impurities in the new glass. It is important for recyclers to collect only clean glass, because one damaged batch may eliminate a market.

Once collected and shipped to manufacturing plants, any remaining contaminants must be removed. Cleaned cullet is added to a batch of raw materials and melted in furnaces. Any remaining paper labels are burned off at this point. Once heated, the molten glass is poured into molds to form the new bottles and jars.

In addition to new beverage containers, cullet can be used to make fiberglass insulation, concrete, polymer composite sewer pipe, brick and terrazzo. It can also be used as a filler in paving making a road surface called glassphalt.

Sources: *Oscar's Options*; Rhode Island Solid Waste Management Corporation 1985 Annual Report; *Looking Good In Ohio's Schools;* Academic American Encyclopedia; *RE:SOURCES* Summer 1986; Worldwatch Paper 76; *RE:THINKING RECYCLING*; Phoebe Philips, *The Encyclopedia of Glass;* Midwest Regional Council.

ALUMINUM

What is Aluminum?

Aluminum is a silvery white metal which constitutes 8% of the earth's crust. It is the third most common element after oxygen and silicon. It is widely dispersed through most clays and rocks, most commonly as hydrated aluminum oxide. It is never found naturally in its metallic state.

There are several characteristics which make aluminum a valuable resource. It is light, strong, and while flexible, can be made more rigid by alloying it with small amounts of other metals. Because of its affinity for oxygen, it resists corrosion by forming a protective coating of aluminum oxide when exposed to the air. Aluminum is a good conductor and insulator.

From what raw natural resources is aluminum made?

The greatest concentrations of aluminum are found in bauxite ore, where it is found as alumina in combination with oxide, titania and silica. Most of the world's bauxite reserves are located in the subtropics where heat and water weather away silica and other contaminants, leaving a higher percentage of aluminum.

Substantial bauxite deposits are located in Jamaica, Australia, Surinam, USSR, Guinea, France, Guinea, Yugoslavia, Greece, Hungary. The limited U.S. reserves are located in Arkansas, Georgia, and Alabama. The U.S. imports 85-90% of its bauxite.

How is it made into metallic form?

Surface mining of bauxite produces solid waste, energy, waterborne waste, air pollution and hazardous waste. Once taken out of the ground, it is transported to refineries around the world. It must then be refined into alumina. 55% of the world's aluminum is produced in the United States, USSR, Canada, Japan, and West Germany.

The oxygen in the alumina is separated out through electrolysis, and combined with small amounts of other metals to strengthen it. The metal is then poured into bars called billets or blocks called ingots. It is then transferred to manufacturing plants which remelt and form the aluminum into various items.

The following resources are used to produce one ton of aluminum: 8,766 pounds of bauxite, 1,020 pounds of petroleum coke, 966 pounds of soda ash, 327 pounds of pitch, 238 pounds of lime, and 197 million BTU's of energy. The pollutants created include: 3,290 pounds of red mud, 2,900 pounds of carbon dioxide, 81 pounds of air pollutants, 789 pounds of solid wastes.

What do we use it for?

Aluminum is used in packaging, building, automobile and aircraft construction. Other applications include electrical transmission, and appliances and other long-life consumer products.

Why recycle aluminum?

Recycling aluminum saves 95% of the energy required to produce it from virgin materials. Recycling an aluminum can will save the equivalent of that can half-filled with gasoline. In addition, 95% of the air pollution is eliminated, and 100% of the solid waste is diverted from landfills.

"The amount of aluminum used in cars made in the United States increased from 78 pounds per car in 1972 to 139 pounds in 1985. The Aluminum Association estimates that this figure could rise to about 200 pounds per car bby the early 1990's From 80 to 90 pecent of the truch trailers in use have aluminum bodies. Aluminum is the primary aircraft material, making up about 80 percent of the structural weight of today's jetliners."

How is aluminum recycled?

"According to Alcoa Aluminum Company, the turn around time for an aluminum can is only six weeks - from manufacturing the can, to filling it, delivering it to the store, being purchased, emptied, recycled by the consumer, shipped to a processing plant, made into cansheet, made into an aluminum can, shipped to the filler, filled, and shipped to the store." Jerry Powell.

Aluminum cans are 100% recyclable. Scrap dealers who receive aluminum from recycling centers sell recycled aluminum to smelters. The smelters must chemically analyze the aluminum they purchase, and shred and decontaminate it. Steel is removed from shredded aluminum as it passes over magnetized conveyor belts. Contamination of more than 1% non-aluminum metals makes the aluminum unusable in a smelter.

Once shredded and decontaminated, the aluminum scrap is melted for eighteen hours during which time, impurities are removed periodically. The molten metal is then poured into forms and allowed to cool. The resulting ingots are transported to manufacturing plants, remelted and formed into new products.

A Recycling Outlook

About 40% of aluminum cans are currently being recycled. Recycling rates are much higher in Bottle Bill States.

"Throughout the 1950's and 1960's, about 75 to 80 percent of all recycled aluminum was "new scrap," or industrial scrap, removed from fabrication plants. However, growing attention to environemntal protection and energy conservation in the 1970's coupled witht the enormous growth of aluminum beverage can recycling, made aluminum scrap an increasingly large proportion of the total aluminum supply. In 1984, about 30 percent of the total aluminum supply in the United States was scrap aluminum - two million net tons, 54 percent was recovered by aluminum manufacturers during fabrcation and 46 percent came from recyclers." (Phoenix Quarterly, winter 1986.)

OTHER METALS

What are iron and steel?

Iron is a naturally occuring pure chemical element. Steel is produced by adding carbon to iron. Other elements are added to this basic recipe to form different grades of steel. Steel is the most widely used metal today. After iron, the most widely used and recycled metals are aluminum, copper, zinc, and lead. Only about 30% of all metal is recycled after its first use; most of the rest eventually becomes "waste." According to World Watch Paper 23, "after five cycles, only one quarter of the metal remains in circulation. After ten cycles, less than one one-thousandth of one percent remains."

What are tin cans?

What we call "tin" cans are really steel cans with a very thin coating of tin. The tin protects the steel from corroding or rusting. Bimetal cans are tin cans with an aluminum top. They used to be common beverage containers thoughout the country. They are less expensive to make than aluminum cans, but are not easily recyclable because they are made from three metals which must be separated again for recycling. You can tell the difference between tin (steel) cans and aluminum with a magnet. Magnets will attract steel but not aluminum. Tin and bimetal cans both attract magnets.

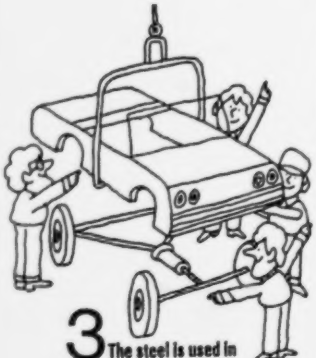
Adapted from November, 1971 *Ranger Rick's Nature Magazine*, published and copyrighted by the National Wildlife Federation, 1412 16th St., N.W., Washington, D.C. 20036. Revised May, 1975, Revised July, 1978.

Recycling

means to use waste material over and over again so as not to use up all our natural resources. Let's see what happens when a car is recycled.

1 Metal ore is mined from the earth. To make an average car it takes: 7500 pounds of iron ore, 2500 pounds of coal and hundreds of pounds of copper, lead, zinc and aluminum ores.

2 The ore is shipped to a steel mill where it is processed to make steel.

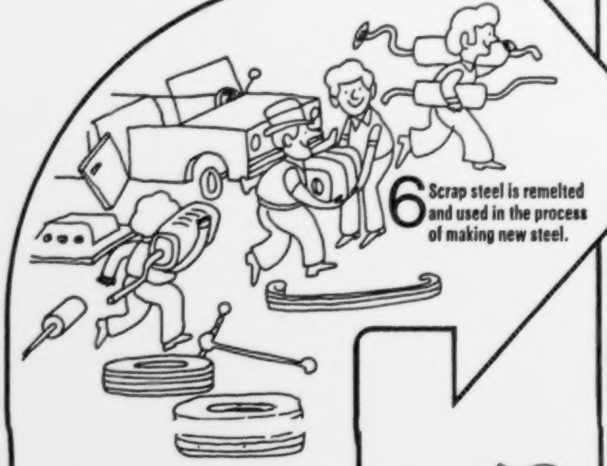


3 The steel is used in making a new car. The car dealer sells the new car.

4 The public buys the new car and uses it for about seven years.

5 When a car wears out it should be sold to an auto wrecker, who removes parts from the car which can be resold or rebuilt. The shell of the car, which is mostly steel, is cut up or squashed. The metal which contains iron, is sold to the steel mill.

Cars which are not recycled end up in ugly junk heaps or are just left to litter the landscape. Both ways are ugly and waste land. Nowadays, thankfully, most junked vehicles are recycled.



6 Scrap steel is remelted and used in the process of making new steel.

Why recycle scrap metal?

In the last twenty years the production of steel from scrap has increased about 20% while raw steel production has declined. An increasing amount of scrap steel is being sent out of the country. Small mills which use electric furnaces to produce a specific products from scrap are called minimills. They bypass the initial stages of mining and processing ore and proceed directly to the fabrication of new products. By doing this they are able to save lots of energy and expense. Mining iron ore and producing steel is hard on the environment and energy-intensive. Using scrap instead of iron ore to make new steel reduces air pollution by 86% and water pollution by 76%, saves 74% of energy and 40% of the water used, and can reduce the need for virgin materials by 90%.

A Recycling Outlook

Large magnets are used to remove ferrous contaminants from aluminum scrap and to isolate ferrous scrap from mixed waste at material recovery facilities. Not very many tin cans have been recycled from Vermont; those that have have primarily found markets in detinning mills in Pennsylvania and Maryland.

The Agency of Natural Resources suggests that in the future, Canadian markets may provide a better market for ferrous scrap in Vermont. The New Hampshire Resource Recovery Association has initiated a scrap recycling program in which the heavy machinery needed to bale scrap is circulated around the state for use at different landfills. Iron is separated into categories at landfills, baled, and sent off into the night. Such large scrap iron includes white goods -- old refrigerators and stoves.

Sources: Pollack, 1987; State of Vermont Solid Waste Plan, 1988; Institute of Scrap Iron and Steel, Inc.

History of Rubber

Rubber was extracted long ago by the Mayans, and used to make waterproof shoes, clothing, bottles, and bouncing balls. It made its way to Europe with Christopher Columbus, and in the 1700's, many experiments were conducted to try to take advantage of its elastic and waterproof characteristics. The "Mackintosh" was an early attempt to waterproof coats by coating them in rubber. But a major stumbling block in the development of rubber was its intolerance for the weather extremes of Europe and North America.

In 1844, Charles Goodyear discovered a way to make rubber sturdy, longlasting and impervious to temperature extremes. He added sulfur to rubber and subjected it to heat, producing a chemical change. Goodyear discovered the process by accident and named it after Vulcan, the Roman god of fire. Because of that discovery, rubber is now used for over 50,000 different applications.

Where does rubber comes from?
Plantations in Indonesia and Malaysia produce most of the natural rubber used today. Rubber trees produce a milky liquid called latex which runs in veins beneath the outer bark. The latex contains pure rubber, water, minerals, and sugars. Trees are tapped in a way similar to the way we tap trees to produce maple syrup. One rubber tree can produce enough latex in a year to make about twelve pounds of rubber. Rubber is composed primarily of tiny particles of carbon and hydrogen held together in long twisted strings. When pulled, these strings stretch out straight giving rubber its elastic quality.

Once the latex is collected, it is strained, poured into large tanks and mixed with acid to cause the rubber particles to mass together. The masses are cut into large slabs and sent through large rolling machines where the water is squeezed out. The rubber is then pressed into bales and shipped to factories.

How is rubber made?

At the factory, the blocks of rubber are cut into smaller pieces and squeezed flat between heated drums in a milling machine. Sulfur, other chemicals, and pigments are added, and the rubber which is naturally light in color darkens. The mixture is rolled out flat and fed through an extruder to achieve the desired shape. Talcum prevents it from sticking as it is further processed. It is fed into a Vulcanizer which heats and chemically changes it, making it sturdy, longlasting and impervious to weather extremes. Finally, the talcom is cleaned off, and the rubber cut to size.

Tires

Synthetic rubber and its chemical additives are manufactured in the U.S. from oil and natural gas. Automobile tires which constitute 60% of the U.S. rubber market, are made from a blend of natural and synthetic rubbers. They also contain a reinforcing fabric made from cloth, plastic and steel and a bead of wire around the rim. This nation currently uses and disposes of some 240 million tires each year. This means an estimated one tire discarded each year for every man, woman and child in Vermont.

Tires cause disposal problems because they are not easily compacted, and unless they are shredded, they tend to float to the surface of a landfill. Stockpiles of tires breed mosquitos, spread disease, attract rodents and are fire hazards.

Rubber can be burned. The Vicon trash-burning facility in Rutland may accept up to 8% of its solid waste or 15 tons per day in tires. Because of their high carbon and hydrogen content and BTU value tires are considered alright to burn. But they produce sulfur dioxide, nitrogen oxides, heavy metals, benzene, other volatile organic compounds and particulate matter that must be carefully dealt with by the burning facility.

Other waste-to-energy incinerators in the United States are designed specifically for tire burning. One $41 million California plant built by Oxford Energy Inc. burns 4 million tires a year 24 hours a day. The plant feeds off of a 42 million tire stockpile it was built next to, and also plans to collect tires for burning at a 35 cents per tire tipping fee. Another similar plant, modelled after a plant in Germany, but 3 to 5 times larger, is proposed for Sterling, Connecticut. It is opposed by local environmental groups concerned by plant emissions.

Ten years ago, about one-fifth of the tires produced in the United States were retreaded. 45 million vehicle tires, including 31 million car tires, were retreaded. Today, this figure has dropped to about 15 million and is expected to drop to only 6 million by the year 2,000. But there are numerous advantages to retreading tires. Tire lifetimes can be up to 90 percent as long as those of new tires. According to Dennis Hayes, "if all tires were retreaded once, the demand for synthetic rubber would be cut by about one-third, tire disposal problems would be cut in half, and substantial energy savings would be realized. Jobs would be lost in the synthetic rubber and new tire industries, but new jobs would be created in the tire recapping business."

Tires can be cut into pieces and used as washers, muffler hangers, shoe soles, boat dock cushions, or doormats. Whole tires are used to build artificial reefs, floating breakwaters, and highway crash barriers. In Vermont, they are often seen as weights holding down plastic coverings on feed bunkers and are used in combination with sand as a floor base in dairy barns.

Tires can be reprocessed into devulcanized rubber or ground up and sold back to rubber companies for use in new rubber products. Eleven million tires can yield 14 million gallons of oil, 10 million pounds of steel and 63 million pounds of carbon black.

Tires can also be ground up into their component parts of rubber, fiber and metal. The resulting crumb rubber is mixed with hot asphalt and used to pave road, track and airport runway surfaces. The results from small test sections done on Interstate 89 in Springfield, Richmond and Derby, Vermont suggest that the best roadway applications for the rubber asphalt are parking lots, driveways and running tracks, where heavy traffic is avoided.

TireCycle, a new process of recycling rubber by adding it to virgin rubber, is currently operating in Minnesota and accepts tires for free. The plant produces about about 1.25 million pounds of new rubber using less than 100,000 old tires. The plant can accomodate up to 4 million tires, but needs to further develop its markets for the new product.

Sources: Hayes,1978; White, 1983; State of Vermont Solid Waste Plan, 1988;LeBlank, 1988; Solid Waste Seminar; "Built to Last--What Can You Do With 240 Million Used Tires?" Environmental Action, March/April 1988.

How are plastics made?

The very first plastics were made from corn starch, but most plastics today are made from natural gas and crude oil. They are made by linking together small single chemical units called monomers in repetition to build one large molecule called a polymer. The plastic monomers are made from hydrogen and carbon elements in combination with small amounts of oxygen, nitrogen and other organic and inorganic compounds. When rearranged chemically, they produce a solid resin. The resins are used to make hundreds of different plastics, all of which fall into two basic categories.

THERMOPLASTICS are formed by combining the same polymer together like molecules of water. Like water, thermoplastics liquify at high temperatures and solidify when cool. This property makes it is easy to melt the plastic and reform it into new objects. Thermoplastics are used primarily for packaging.

[polyethelene (low density and high density)] margarine tubs, coffee can lids, squeeze bottles, film, pipe and tubing, plastic flowers, detergent and bleach bottles, milk and juice jugs.

[polystyrene] styrofoam, wall tile, packaging.

[polyvinyl chloride (PVC)] shower curtains, phonograph records, garment bags, raincoats, insulation.

[polypropylene] packaging, hard hats, pipes, auto parts, toys, housewears, packaging films.

THERMOSETTING PLASTICS are formed by combining different polymer molecules. Once linked together in a chemical reaction, they are impossible to separate. They cannot be melted and reformed into new shapes and so are difficult to recycle. Thermosets are widely used in furniture, toys, table ware, computer casings, and other permanent uses requiring a hard plastic. Polyester, epoxies, and melamine are all thermoset plastics.

Why is the use of plastics increasing?

Plastics currently comprise about eight percent of our solid waste stream, a share that has steadily increased since they first entered the consumer market thirty years ago. Their popularity has increased for several reasons. They are durable, lightweight, waterproof, require less secondary, protective packaging, add to consumer convenience, and are relatively inexpensive to produce. Their chemical properties can be manipulated to achieve just the right combination of properties for any application.

In what ways are plastics a problem?

Plastics are made from a non-renewable resource. Although some plastics are relatively inexpensive to manufacture, the crude oil and natural gas from which they are made comes from limited supplies, the increasingly complicated extraction of which often have serious, negative environmental and/or political impacts.

The same characteristics which make plastic an attractive packaging material also make it a special problem in the waste stream. Though lightweight, plastic is bulky and difficult to compact for shipping or for burial in landfills. Plastic will not biodegrade. Photodegradable plastics may break down into smaller pieces when exposed to enough sunlight, but will never really disappear.

Plastic litter causes particular problems in our oceans and on our beaches. Thousands of fish, sea mammals and birds have died because they have eaten or gotten tangled in discarded fishnets, six-pack rings, plastic bags and other packaging material. Virtually all our beaches and waterways are now polluted with unsightly plastic waste.

Approximately one-half of all foam packaging as of 1986 was inflated with chlorofluorocarbons. Both the manufacturing process and the packaging itself release CFCs intc the atmosphere. Rigid foam products account for one-quarter of the world's use of the two most ozone-threatening CFCs. By 1990 manufacturers in the United States are now required to stop the use of CFCs; however, U.S. manufacturers account for only a small percent of CFC use worldwide.

Because they are made from fossil fuels, plastics also have a high BTU value and so can be said to be a good burning fuel. However some plastics emit toxic fumes when burned. Polyvinyl chloride, for instance, when burned, releases chlorine compounds into the atmosphere, if not controlled. These contribute to depletion of the ozone layer, a global problem receiving increasing attention. Other plastic ingredients can clog the inner workings of incinerators.

What are photo-degradable and bio-degradable plastics?

Photo-degradable plastics are plastics which have some of their chemical bonding made with compounds that disintegrate with prolonged exposure to sunlight. These plastics are being used for beverage "six-pack" rings, shopping bags, and in some commercial agricultural applications (drying trays for raisins). They do deteriorate into smaller pieces of plastic, but do not in fact decompose.

True bio-degradable plastics, plastics that disintegrate into organic substances as the result of natural processes, are largely experimental and have not come into wide use because of their relative high cost. "Biodegradable plastics are made by fermentation of natural substances such as sugar and other carbohydrates. One firm has produced biodegradable plastic with the help of a vigorous strain of bacteria found in canals. The bacteria are cultivated in vats and fed a sugary diet on which they thrive. In doing so they multiply and produce biological "plastic" rather like mammals make fat in their bodies as they grow. The plastic is extracted in fermentation vessels, and is then dried and sold as granules. This plastic is readily broken down by algae, fungi, or bacteria in the soil. A bag made from it will disappear within twelve or fifteen months or indeed within only three of four months if it is placed in a compost heap." (Seymour, 1987)

Recently the "bio-degradable" label has been used for a number of plastics (particularly shopping bags) that use cornstarch or other organic substances as bonding agents in or in combination with crude-oil plastics. Like photo-degradable plastics, these plastics do deteriorate as their organic matter decomposes, but they in fact degrade into smaller pieces of plastic which do not bio-degrade.

How are plastics recycled?

Plastics must first be sorted by resin type. They can then be baled or shredded for transportation to a remanufacturing plant. Thermoplastics are easily recycled by melting and reforming them into new shapes.

Because plastic molecules migrate and can be contaminated with food particles, recycled plastic cannot be used for food containers. They are used as a filler layer in food packaging as long as they don't come into direct contact with the food. The quality of recycled plastic depends on how well the scrap is separated prior to recycling. The less control over this process, the poorer quality product results.

Polyethelene terephalate (PET) soda bottles are shredded into fibers and woven back into threads to make clothing or used to stuff sleeping bags, quilts, and parkas.

Plastic milk jugs, juice jugs, bleach bottles and detergent bottles are made of high density polyethelene (HDPE). They are commonly recycled into construction materials such as railroad ties, parking blocks, piping, and beams can be made from recycled plastic.

Why are plastics hard to recycle?

There are hundreds of different kinds of plastics, more than 46 of which are in common use. Each type has a different chemical composition and is carefully engineered for a specific purpose. Layers of different plastics can be used in just one container, each adding a special quality to the design. By sight, these chemical recipes are indistinguishable.

The success of plastics recycling depends in part on the proper identification and separation of plastics. PET soda bottles and milk and cider jugs as well as detergent and waste oil containers are beginning to find markets for recycling because they are made from one kind of plastic and are easily identifiable. But recycling for other plastic films, food containers, lids, wraps, tapes, etc. is still not feasible. The Society of Plastics Industry has recently developed a voluntary coding system so that plastics can be easily identified and separated by sight and this may facilitate recycling. Research is also being done on melding unsorted plastics into a composite material, primarily envisioned for use as a building material.

Transporting plastics for recycling is expensive because they are lightweight and bulky. While secondary plastics are commanding high prices now, the cost of transporting a ton of plastic is much greater than any other recycled material. The sale price of the material is quickly eaten up by the costs of getting it to market.

Sources: Pollack,1987; Pess, 1985; Oregon DEQ.

INFORMATION I.A.6.a HOUSEHOLD HAZARDS

(See also State of Vermont Household Hazardous Waste chart)

What is Household Hazardous Waste (HHW)?

A hazardous waste is a discarded substance whose chemical or biological nature makes it potentially dangerous to people or wildlife. Our homes contain many hazardous substances, and pose a threat to our health if they are not used, stored, and disposed of properly. Haphazard disposal of hazardous waste hurts our environment whether it comes from industry or homes.

Why are wastes hazardous?

Wastes are considered hazardous due to the way they affect humans or react with other chemicals. They are usually grouped into the following five categories: caustic, if they destroy living tissue; explosive, if they react violently with exposure to other chemicals or heat; infectious, if they can cause or transmit disease; toxic, if they are poisonous; or radioactive, if they give off radioactive particles.

What are some examples of HHW?

HHWs include pesticides, auto fluids, both car and household batteries, drain cleaners, solvents, paints, and varnishes and many other products which will pollute the liquid (sewage) and solid waste streams. The majority of HHWs come from maintenance items around the house. By weight paints and varnishes discarded in landfills constitute about 50% of the problem; household batteries (high in mercury) are the second biggest problem.

How much do we have in our homes?

Almost every American home is a hazardous waste generator. It is estimated that the average home stores between three and ten gallons of such waste. The Environmental Protection Agency estimates that over one million tons of HHW are produced in the United States each year, the use averaging out to 21 pounds or 25 gallons per person per year.

What are the problems associated with HHW?

Although HHWs contribute to less than 1% of the municipal waste stream, they still have great potential to pollute the environment through improper disposal in landfills, down drains, and by on-site disposal (e.g. pouring waste oil on the road) and illegal dumping. Disposal of HHW in a landfill makes its leachate hazardous and threatens groundwater, and disposal in septic and municipal sewage systems taxes municipal wastewater treatment facilities and may make disposal of their sludge difficult. Although we are speaking of relatively small quantities, parts per million or even parts per billion of some substances will render a water supply undrinkable and dangerous to humans and other life. Many chemicals can produce such an effect after accumulation of minute amounts over many years.

The impact of low level, long-term exposure to many chemicals present in our homes and the environment is still unknown; however, children, the elderly, and adults with asthma and allergies are known to be most susceptible to any effects. Some researchers warn that very brief exposures to some substances found in many household products may be all that is needed to cause irreversible harm to ourselves and the environment.

How should we use hazardous products?

For household tasks such as painting or cleaning, select the most suitable materials for the job. Then check to see if you or your neighbor already has these on hand. If a new purchase is needed, always look for products that will minimize or eliminate health risks and future disposal problems. (A list of suggested products may be obtained from the State of Vermont or your regional solid waste district.) If potentially hazardous substances cannot be avoided, make sure you read their labels; follow the directions properly; apply the substance properly (using appropriate safety precautions, including the right gloves or eye protection); and use leftovers for other similar projects and/or recycle them when appropriate.

How should we dispose of HHW?

When the job is finished, leftover chemicals should be stored safely in the home--read the original product for safe storage requirements; clearly label the storage container; use non-breakable, preferably non-plastic containers (to avoid potential chemical reactions); secure in a tamper proof area (inaccessable to children and animals); and check regularly for any leaks. Also keep the products away from moisture, water, and food, and never mix one product with another in the same container.

Waste oils and batteries should be recycled whenever possible (see information on these materials in this guide). They should never be landfilled, nor disposed of improperly. Banned and other pesticides, acids, corrosives, and their empty containers, as well as flammables, outdated medicines, paints, paint removers and wood preservers should be stored until there is a scheduled household hazardous waste collection day in your area.

In order to avoid storing hazardous chemicals in your home, and being resposible for their ultimate disposal, it is best to use safe alternatives whenever possible. Every spill, leak, and mishandling of hazardous materials poses a threat to our health, the environment, and future generations. When there is no substitute, use a hazardous product sparingly, for the appropriate task, and store until you can dispose of properly.

[Thanks to Michael Bender of the Central Vermont Regional Planning Commission for drafting this material.]

What is Waste Oil?

Americans generate more than 600 million gallons of used motor oil each year. The Agency of Natural Resources has estimated that in 1987, registered vehicles in Vermont produced 710,000 gallons of waste oil. If improperly disposed, this waste oil can seriously harm our environment.

Many additives and contaminants help make waste oil toxic. 10 to 20% of automotive oil is composed of substances which are added to perform a certain function such as to inhibit rust or prevent foaming. Oil will also pick up sediment and gasoline components and additives from the engine during combustion. High levels of lead, as well as other toxics including benzene, cadmium, zinc, magnesium and PCB's are all added to the waste oil and may contaminate our environment if the oil is not disposed of properly.

Why is Waste Oil dangerous?

Small amounts of waste oil can contaminate large water supplies. One gallon of oil will spoil 250,000 gallons of water. You can taste less than 300 parts per million of oil in fish and smell and taste only 5 parts per million in water. Just one pint of motor oil can create a slick an acre in size on surface water and will kill floating aquatic organisms such as diatoms and other algae on contact. The whole food chain depends on these organisms. The oil will also encourage the growth of organisms that deplete the dissolved oxygen supply available to fish and other aquatic life. Human health is threatened by waste oil if we drink water contaminated with it, if we eat fish or animals who have ingested it, of if our skin is exposed directly to it for long periods of time.

There are many ways in which the 240 million gallons of waste oil enter and pollute our environment each year. Many people change their own automobile oil and often dispose of the waste oil on the ground, down sewer drains and sinks, or throw it out with their trash. Lack of disposal opportunities and a limited knowledge of the associated environmental and health hazards are prime causes of improper disposal. Because of changing markets and the expense of reprocessing the waste oil, it has been difficult to find gas stations or disposal facilities willing to take oil for recycling.

How is Waste Oil recycled and reused?

Waste oil can be rerefined and used again indefinitely as a lubricant. One gallon of used oil can make two and one-half quarts of lubricating oil, while it takes 42 gallons of crude oil to produce the same amount. The rerefining industry was once very healthy, but in 1950's the Federal Trade Commission began requiring a "previously used" label on processed used oil. This resulted in a misconception that rerefined oil was inferior to virgin oil and the industry suffered terribly.

It can also be reprocessed to use as a fuel or fuel supplement or to manufacture other petroleum-based products. If used as a fuel, waste oil needs to be properly cleaned to remove the toxics that would pollute the air if left in the oil and burned. ANR estimates that 90% of the waste oil generated annually in Vermont is reused. Gas stations often burn waste oil in furnaces or give it away for sugaring or brushburning. Waste oil is also used to oil Vermont roads and as lubrication for farm vehicles and automobiles.

Sources: "Used Oil", Solid Waste Division report to the Technical Advisory Committee, 1988; Agency of Natural Resources. *State of Vermont Solid Waste Management Plan*; Oregon DEQ; Michigan State University Cooperative Extension Service, *Used Oil Recycling.*

INFORMATION I.A.6.c BATTERIES

What are Batteries?

Batteries convert chemical energy into electrical energy. The basic battery cell consists of a positive and a negative electrode partially and an electrolyte, through which the electrical current passes. Primary drycell batteries (most common household batteries) must be disposed after they are used, while the chemical reaction in secondary wetcell batteries (car batteries) can be reversed so the batteries can be recharged and used again.

The average American family uses 32 dry cell batteries annually in toys, flashlights, hearing aids, tape recorders, radios, cameras, calculators and other common household items. In addition to smaller amounts of copper, zinc, manganese, nickel and lithium, batteries use 25% of the cadmium, 45% of mercury, and 66% of the lead produced in this country. The Agency of Natural Resources has estimated that Vermonters purchase and dispose of 75,000 wet cell and over four million dry cell batteries each year.

Why are Batteries a problem?

Once in the waste stream, batteries threaten our environment in two ways. As batteries break apart in landfills or dumps, heavy metals leach into ground and surface water. When incinerated, these metals cannot be destroyed and are either released as particulates into the atmosphere or trapped in the incinerator ash and landfilled, where they contaminate water sources and threaten our health.

How can Batteries be recycled?

There are safer alternatives to adding batteries to our residential waste stream. Although technologies and markets are limited, some batteries can be recycled. Currently, the most easily recycled are the button cell batteries used in hearing aids and cameras. Other batteries which cannot be recycled should still be separated out of the trash and saved for household hazardous waste collection days.

Mercury is recovered from some batteries by baking them until the compounds break down, the mercury is released as a vapor, trapped and converted back to a liquid. Another method breaks down silver and mercury batteries through heating, dissolves them in acids, precipitates out the silver, and removes the mercury through electrolysis. Other technologies for recovering cadmium and alkaline from batteries have been developed in Europe and Japan but are not available in this country.

Car batteries should be easily recyclable because they are easily identifiable and have a high lead content. However, the increasing difficulty and expense of transporting hazardous waste has resulted in a decrease of recycling these batteries.

One Battery Recycling Program

The NH/VT Solid Waste Project in Claremont started a program in 1987 to remove household batteries from the waste stream. Keeping incinerator emissions clean at the Signal Waste-to-Energy Incinerator provides an incentive for the program. About a hundred area stores who sell batteries participate by displaying recycling collection buckets. Local volunteer organizations regularly collect the batteries. They are stored in in 55-gallon drums, until enough have been collected. They are then separated; most are set aside for household hazardous waste collection days, while those containing mercury and silver are sent to the mercury Refining Company of Albany, NY to be recycled.

Sources: *Vermont Solid Waste Management Plan - 1988*; Taylor, Kevin, David Hurd, and Brian Rohan. "Recycling in the 1980's: Batteries not included." *Resource Recycling*, May/June 1988; Dadd, Debra Lynn. *The Nontoxic Home;* Leach, Constance A. Household Batteries. presented at Penn. Recycling Conference in Grantsville, May 1-3, 1988.

What purposes does packaging serve?

Packaging protects its contents from physical damage and spoilage, and may also be used to ensure that contents are sanitary. By reducing spoilage and damage, it reduces the volume of solid waste. Labels on packaging identify contents and provide directions for use. Packaging may help retailers advertise their goods, keep sales records straight, and discourage theft. It also makes possible national marketing and distribution of goods. It provides consumer convenience and may reduce waste of its contents by dividing food and beverages into individualized portions.

In what ways is packaging a problem?

Packaging substantially contributes to the volume of solid waste needing disposal, depletes limited resources, adds to litter and pollution, and increases the cost of a product. Almost all packaging is meant to be disposed of after one use. Some packaging materials contribute nonbiodegradable or toxic materials to the environment.

What is excessive packaging?

Excessive packaging is often in the eye of the beholder. Generally packaging that is related purely to retailer and consumer convenience and marketing, or that is not related to protecting contents from damage or spoilage, may be considered excessive.

What is harmful packaging?

Harmful packaging is packaging that through its manufacture or use hurts the health of humans, animals, plants, or the environment. Such packaging rarely remains in use (at least in the United States) once a scientific consensus develops that it is harmful and government action is taken. However, it often takes decades for such a consensus to develop; it took at least two decades for consensus to be achieved on the harmful effects of chloroflourocarbons (CFCs) used in polystyrene.

How can excessive or harmful packaging be reduced?

Conferring with packaging manufacturers and large-scale packagers may help by encouraging voluntary packaging reduction and research into new, less harmful or wasteful packaging. Packaging regulation by federal and state governments may help by reducing excess or environmentally harmful packaging, and promoting the use of reusable and recyclable packaging. Such regulation can take the form of deposits, taxes, labeling, regulatory review, bans on specific packages, financial incentives (tax breaks or penalties), and packaging standardization.

"WHAT MAKES A "GOOD" PACKAGE?

According to the consumer, a "good" package would be easy to carry, open and reseal; inexpensive; protective; convenient,non-breakable, reusable. According to the manufactureer, a "good" package would be designed to sell a product; protective; lightweight for inexpensive transportation; non-breakable; designed for easy handling. According to a retailer, a "good" package would be difficult to steal or damage; convenient; able to hold up well in storage; able to maintain an attractive appearance in artificial light. According to a solid waste disposer, a "good" package would be reusable, refillable, recyclable, biodegradable, and/or compactible."
(Oregon DEQ, 1980.)

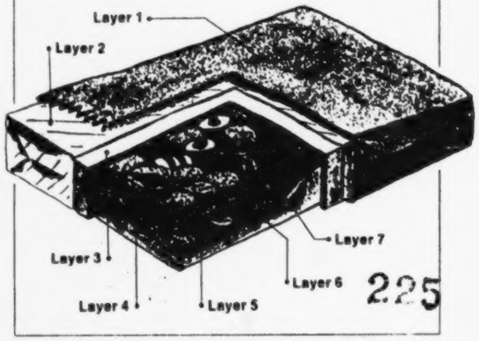
PACKAGING FACTS

- "Out of every dollar a consumer spends, about ten cents goes for the packaging. For each dollar spent on food, about $ .13 goes to pay for the package. And for each dollar spent on cosmetics, up to $.30 goes for the package." (Oregon DEQ, 1980.)
- "In industrial countries, packaging contributes about 30% of the weight and 50% of the volume of household waste." (Worldwatch Paper 76)
- "While two quarts and one half gallon deliver identical amounts of milk, the half-gallon container uses 8.5% less paper and plastic than two quart containers do, and costs 40% less to produce. If the over 70 million American households bought one half gallon of milk a week instead of two quarts, they would reduce paper discards by 41.6 million pounds and plastic discards by 5.7 million pounds per year. They would save $145.6 million in packaging, along with over one trillion BTU's of energy, enough to heat and cool 7,500 households for an entire year." (The Futurist, February 1981)
- "The average American discards almost 300 kilograms of packaging each year. In the United States, more than one-half of the paper and glass produced, and about one-third of the plastics are incorporated in items with a lifespan of under one year. Producing these packaging materials consumes three percent of the national energy budget." (Worldwatch #76, 1987.)
- "The production of packages and containers is a forty-nine billion dollar industry in the United States; employing about four hundred and fifteen thousand people; with an annual payroll of close to nine billion dollars." (Joseph Cavanagh, 1986)
- "90% of all packaging ends up in the trash." (Oregon, DEQ)

THE OVERPACKAGING TEST

A revealing way to examine packaging is to count up the number of separate layers that surround whatever it is that you are buying. There are few products that really need more than two layers of packaging, but many have far more than that. Luxury items are the worst offenders: the less essential a product is, the more it will be wrapped up – as can be seen here with a box of chocolates.

Seven-layer packaging



From *Blueprint for a Green Planet* by John Seymour and Herbert Girardet (c) 1987
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Table 20.6 Major Reserves of Selected Minerals, 1988

	Bauxite (million metric tons)		Copper (million metric tons)		Iron Ore (million metric tons)		Lead (thousand metric tons)		Manganese (million metric tons)		Nickel (thousand metric tons)		Tin (thousand metric tons)		Zinc (million metric tons)	
	Reserves	Reserve Base	Reserves	Reserve Base	Reserves	Reserve Base	Reserves	Reserve Base	Reserves	Reserve Base	Reserves	Reserve Base	Reserves	Reserve Base	Reserves	Reserve Base
WORLD	**2,100**	**23,200**	**340**	**570**	**153,418**	**216,408**	**75,000**	**125,000**	**907**	**3,538**	**51,710**	**100,699**	**4,260**	**4,280**	**148**	**295**
AFRICA	**7,000**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**9**	**23**
Botswana	X	X	X	X	X	X	X	X	X	X	408	454	X	X	X	X
Cameroon	680	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Gabon	X	X	X	X	X	X	X	X	100	172	X	X	X	X	X	X
Ghana	450	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Guinea	5,600	5,900	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Liberia	X	X	X	X	508	813	X	X	X	X	X	X	X	X	X	X
Mozambique	2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Namibia	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Nigeria	X	X	X	X	X	X	X	X	X	X	X	X	20	20	X	X
Sierra Leone	140	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
South Africa	0	X	X	X	4,064	9,449	4,000	6,000	369	2,631	2,540	2,631	X	X	3	14
Zaire	X	X	26	30	X	X	X	X	X	X	X	X	20	20	5	7
Zambia	X	X	16	34	X	X	X	X	X	X	X	X	X	X	X	X
Zimbabwe	2	X	X	X	X	X	X	X	X	X	181	1,724	X	X	X	X
NORTH & CENTRAL AMERICA	**2,120**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**52**	**114**
Canada	X	X	17	23	11,887	25,502	8,000	15,000	X	X	7,258	13,427	60	60	25	56
Costa Rica	78	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Cuba	X	X	X	X	X	X	X	X	X	X	18,144	22,680	X	X	X	X
Dominican Rep	30	X	X	X	X	X	X	X	X	X	726	998	X	X	X	X
Haiti	10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Jamaica	2,000	2,000	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Mexico	0	X	X	X	X	X	3,000	4,000	3	8	X	X	X	X	6	8
United States	38	40	57	90	16,053	25,197	11,000	22,000	X	X	272	2,540	20	40	21	50
SOUTH AMERICA	**4,000**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**10**	**18**
Bolivia	X	X	X	X	X	X	X	X	X	X	X	X	140	140	X	X
Brazil	2,250	2,900	X	X	15,850	17,577	X	X	19	63	726	13,427	650	650	2	3
Chile	X	X	79	120	X	X	X	X	X	X	X	X	X	X	X	X
Colombia	0	X	X	X	X	X	X	X	X	X	590	635	X	X	X	X
French Guiana	42	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Guyana	700	900	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Peru	X	X	12	32	X	X	2,000	3,000	X	X	X	X	X	X	7	12
Suriname	575	600	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Venezuela	235	350	X	X	2,032	2,032	X	X	X	X	X	X	X	X	X	X
ASIA	**2,000**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**23**	**39**
Burma	X	X	X	X	X	X	X	X	X	X	X	X	20	20	X	X
China	150	X	X	X	9,144	9,144	X	X	14	29	X	X	400	400	5	9
India	1,000	1,200	X	X	7,214	12,090	X	X	18	27	X	X	X	X	5	7
Indonesia	750	X	X	X	X	X	X	X	X	X	3,901	5,262	680	680	X	X
Iran	0	X	X	X	X	X	X	X	X	X	X	X	X	X	2	6
Japan	X	X	X	X	X	X	X	X	X	X	X	X	X	X	4	6
Korea, Dem Rep	X	X	X	X	X	X	X	X	X	X	X	X	X	X	4	6
Malaysia	15	X	X	X	X	X	X	X	X	X	X	X	1,100	1,100	X	X
Pakistan	20	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Philippines	0	X	12	18	X	X	X	X	X	X	1,814	4,627	X	X	X	X
Thailand	X	X	X	X	X	X	X	X	X	X	X	X	270	270	1	1
Turkey	25	X	X	X	X	X	X	X	X	X	X	X	X	X	1	1
EUROPE	**1,500**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**36**	**54**
Albania	X	X	X	X	X	X	X	X	X	X	181	181	X	X	X	X
Finland	X	X	X	X	X	X	X	X	X	X	36	45	X	X	1	2
France	30	X	X	X	2,235	2,235	X	X	X	X	X	X	X	X	1	1
Germany, Fed Rep	2	X	X	X	X	X	X	X	X	X	X	X	X	X	1	2
Greece	600	650	X	X	X	X	X	X	X	X	2,359	2,540	X	X	1	1
Hungary	300	300	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Ireland	X	X	X	X	X	X	X	X	X	X	X	X	X	X	5	7
Italy	5	X	X	X	X	X	X	X	X	X	X	X	X	X	2	3
Poland	X	X	10	15	X	X	X	X	X	X	X	X	X	X	3	4
Portugal	X	X	X	X	X	X	X	X	X	X	X	X	X	X	2	3
Romania	50	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Spain	5	X	X	X	X	X	X	X	X	X	X	X	X	X	5	6
Sweden	X	X	X	X	3,048	4,674	X	X	X	X	X	X	X	X	1	3
United Kingdom	0	X	X	X	X	X	X	X	X	X	X	X	90	90	X	X
Yugoslavia	350	400	X	X	X	X	2,000	3,000	X	X	1,270	1,633	X	X	2	3
USSR	**300**	**300**	**37**	**54**	**59,944**	**59,944**	**X**	**X**	**295**	**454**	**6,623**	**7,348**	**300**	**300**	**10**	**18**
OCEANIA	**4,500**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**4,300**	**23,700**	**X**	**X**	**X**	**X**
Australia	4,440	4,600	8	41	15,240	33,528	16,000	28,000	68	152	2,087	4,808	250	250	18	49
New Caledonia	X	X	X	X	X	X	X	X	X	X	1,814	15,422	X	X	X	X
Solomon Islands	50	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Other Market Economies	2,600	2,900	60	100	4,877	12,294	9,000	14,000	X	X	X	7,893	200	200	X	X
Other CPEs[a]	200	200	6	9	914	914	20,000	30,000	X	X	X	907	30	30	X	X

Source: U.S. Bureau of Mines.
Note: a. Centrally Planned Economies.
X = not available.
For additional information, see Sources and Technical Notes.

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Table 20.5 Producers and Consumers of Selected Metals, 1965–86

	Annual Production (thousand metric tons)				
	1965	1970	1975	1980	1986
ALUMINUM					
United States	2,499	3,607	3,519	4,654	3,037
USSR	840	1,100	1,530	1,760	2,300
Canada	753	972	887	1,068	1,360
Australia	88	206	214	303	882
Germany, Fed Rep	234	309	678	731	765
Brazil	33	62	121	260	762
Norway	279	522	595	653	712
Venezuela	0	25	45	321	424
China	100	130	200	360	410
Spain	52	120	210	386	375
Ten Countries Total	**4,878**	**7,052**	**7,999**	**10,497**	**11,027**
World Total	**6,318**	**9,653**	**12,145**	**15,383**	**15,314**
COPPER					
Chile	606	711	828	1,068	1,386
United States	1,226	1,560	1,282	1,181	1,022
Canada	461	610	734	716	768
USSR	323	451	580	590	620
Zaire	289	387	495	540	563
Zambia	696	684	677	596	450
Poland	15	72	230	346	431
Peru	180	220	193	367	397
Mexico	55	61	79	175	285
Australia	92	158	219	244	239
Ten Countries Total	**3,943**	**4,914**	**5,317**	**5,822**	**6,161**
World Total	**4,690**	**6,262**	**7,000**	**7,394**	**8,156**
LEAD					
Australia	368	457	408	397	435
USSR	350	440	480	420	440
United States	273	519	564	550	353
Canada	275	353	349	297	304
Mexico	167	177	179	147	200
Peru	154	157	184	189	194
China	100	100	100	160	160
Yugoslavia	106	127	127	121	110
Korea, Dem Rep	60	70	120	125	110
South Africa	0	0	3	86	98
Ten Countries Total	**1,793**	**2,328**	**2,390**	**2,281**	**2,403**
World Total	**2,753**	**3,471**	**3,581**	**3,577**	**3,239**
NICKEL					
USSR	85	110	152	154	186
Canada	242	277	242	185	181
Australia	0	30	76	74	70
New Caledonia	31	105	133	87	65
Indonesia	4	16	15	53	44
Cuba	X	35	37	37	33
South Africa	3	12	21	26	25
China	X	X	X	X	25
Dominican Rep	0	X	27	16	22
Colombia	X	X	X	15	22
Ten Countries Total	**365**	**585**	**702**	**632**	**672**
World Total	**426**	**628**	**808**	**759**	**784**
TIN					
Malaysia	64	73	64	61	28
Brazil	2	4	5	7	27
USSR	23	27	30	36	24
Indonesia	15	19	25	33	22
Thailand	19	21	16	34	17
China	25	20	22	15	15
Bolivia	23	29	24	22	12
Australia	4	9	10	12	9
Peru	0	0	0	1	5
United Kingdom	1	2	3	3	5
Ten Countries Total	**178**	**204**	**200**	**223**	**163**
World Total	**205**	**217**	**219**	**238**	**180**
ZINC					
Canada	826	1,239	1,229	1,059	1,294
USSR	470	610	690	785	810
Australia	355	487	501	495	662
Peru	254	299	385	488	598
China	100	100	100	160	396
Mexico	225	266	289	236	285
United States	554	485	426	317	216
Spain	39	98	84	183	223
Japan	221	280	254	238	222
Sweden	79	93	111	167	214
Ten Countries Total	**3,024**	**3,857**	**3,970**	**3,968**	**4,920**
World Total	**4,235**	**5,615**	**6,111**	**6,213**	**6,853**
IRON ORE					
USSR	153,432	195,492	232,803	244,713	249,000
Brazil	20,754	40,200	89,894	114,732	132,000
Australia	6,803	51,189	97,651	95,534	90,000
China	39,000	40,400	65,000	68,000	90,000
India	23,830	31,366	41,405	41,936	47,800
United States	88,842	91,201	80,132	70,730	39,448
Canada	36,250	47,459	46,868	48,754	36,070
South Africa	5,816	7,728	12,298	26,312	24,483
Sweden	29,354	31,509	30,867	27,184	20,489
Venezuela	17,510	22,100	24,772	16,102	19,100
Ten Countries Total	**421,592**	**558,643**	**721,691**	**753,999**	**737,548**
World Total	**620,982**	**769,163**	**902,018**	**895,867**	**847,775**
CRUDE STEEL					
USSR	91,000	115,886	141,325	147,941	161,000
Japan	41,161	93,322	102,313	111,395	98,275
United States	118,985	119,305	105,816	101,455	73,001
China	15,000	18,000	25,000	37,120	52,100
Germany, Fed Rep	36,821	45,041	40,415	43,838	37,134
Italy	12,681	17,277	21,836	26,501	22,872
Brazil	3,024	5,390	8,308	15,339	21,234
France	19,604	23,773	21,530	23,176	18,000
Poland	9,088	11,795	15,007	19,485	17,100
Czechoslovakia	X	X	X	X	15,000
Ten Countries Total	**347,364**	**449,790**	**481,549**	**526,249**	**516,231**
World Total	**459,300**	**594,418**	**643,798**	**713,788**	**714,970**

	Annual Consumption (thousand metric tons)				
	1965	1970	1975	1980	1986
ALUMINUM					
United States	2,852	3,488	3,265	4,454	4,268
USSR	1,000	1,281	1,580	1,850	1,885
Japan	286	930	1,171	1,639	1,624
Germany, Fed Rep	387	670	704	1,042	1,186
China	95	180	300	550	750
France	249	413	399	601	593
Italy	128	279	270	458	510
Brazil	52	84	209	296	424
Canada	182	250	293	312	405
United Kingdom	364	404	393	409	389
Ten Countries Total	**5,412**	**7,729**	**8,291**	**11,299**	**12,033**
World Total	**6,699**	**9,928**	**11,299**	**15,285**	**16,396**
COPPER					
United States	1,819	1,854	1,397	1,868	2,102
Japan	428	821	827	1,158	1,219
USSR	408	841	1,035	990	1,300
Germany, Fed Rep	536	698	635	748	771
China	120	200	315	386	471
France	287	331	365	433	401
Italy	192	274	299	388	395
United Kingdom	650	554	451	409	340
Belgium	99	145	177	304	303
Korea, Rep	2	8	28	84	264
Ten Countries Total	**4,538**	**5,717**	**5,500**	**6,684**	**7,565**
World Total	**5,750**	**7,172**	**7,260**	**9,086**	**10,073**
LEAD					
United States	754	894	820	1,094	1,119
USSR	385	486	620	800	760
Japan	147	211	189	393	389
Germany, Fed Rep	271	309	225	333	359
United Kingdom	312	262	238	296	282
Italy	94	168	146	275	232
China	100	160	185	210	225
France	145	193	174	213	205
Yugoslavia	43	45	83	128	145
Bulgaria	X	77	95	110	116
Ten Countries Total	**2,250**	**2,803**	**2,775**	**3,851**	**3,832**
World Total	**3,179**	**3,914**	**4,759**	**5,392**	**5,489**
NICKEL					
USSR	110	130	115	132	146
Japan	27	98	90	122	127
United States	156	141	133	142	125
Germany, Fed Rep	31	41	43	68	77
France	21	36	32	38	32
Italy	9	20	17	27	30
United Kingdom	37	35	21	23	27
China	X	X	18	18	20
Sweden	13	23	22	20	17
India	X	X	3	12	16
Ten Countries Total	**404**	**524**	**494**	**602**	**616**
World Total	**428**	**567**	**570**	**715**	**792**
TIN					
United States	63	57	56	56	44
Japan	18	29	28	31	32
USSR	29	17	23	25	26
Germany, Fed Rep	13	15	13	16	17
China	15	13	14	13	12
United Kingdom	21	19	14	10	10
France	10	11	10	10	8
Brazil	2	3	3	5	6
Netherlands	4	6	4	5	6
Italy	6	7	8	6	6
Ten Countries Total	**175**	**168**	**166**	**171**	**159**
World Total	**223**	**225**	**216**	**224**	**228**
ZINC					
United States	1,221	1,074	839	810	999
USSR	401	510	900	1,030	990
Japan	322	623	547	752	753
Germany, Fed Rep	334	396	297	406	434
China	100	150	220	200	360
France	186	220	223	330	261
Italy	116	178	150	236	232
United Kingdom	282	278	207	181	182
Belgium	123	128	103	155	172
Poland	114	129	152	178	157
Ten Countries Total	**1,949**	**2,592**	**2,797**	**3,423**	**3,335**
World Total	**4,054**	**5,042**	**5,036**	**6,181**	**6,323**
IRON ORE					
USSR	128,895	159,392	189,177	218,417	201,078[a]
Japan	62,286	106,708	140,584	140,899	130,451[b]
China	38,500	44,000	66,400	80,900	94,000[b]
United States	125,132	133,676	115,952	100,461	73,674[a]
Germany, Fed Rep	44,392	54,141	48,216	53,353	50,256[b]
Brazil	5,429	10,476	11,395	19,984	26,424[b]
France	37,735	40,717	34,452	34,483	25,033[b]
Italy	8,606	12,438	17,916	20,695	20,529[b]
Czechoslovakia	10,856	15,780	17,720	18,894	17,919[b]
Poland	11,664	13,918	14,097	20,985	17,218[b]
Ten Countries Total	**473,495**	**591,246**	**655,909**	**709,071**	**656,582[b]**
World Total	**620,982**	**769,163**	**902,018**	**895,867**	**858,817[b]**
CRUDE STEEL					
USSR	91,000	115,873	141,325	147,931	159,945[a]
United States	125,723	124,514	113,945	111,525	103,779[a]
Japan	31,548	75,835	73,469	82,784	76,638[b]
China	X	X	X	37,217	54,351[a]
Germany, Fed Rep	32,851	41,983	32,959	27,690	31,920[b]
Italy	12,296	20,539	18,618	26,808	22,402[a]
Brazil[c]	3,013	5,178	8,280	11,740	9,249[a]
France	16,935	24,175	20,297	16,457	15,945[b]
Poland	8,659	11,739	17,328	15,000	15,352[b]
United Kingdom	24,076	26,416	20,729	14,962	14,667[b]
Ten Countries Total	**346,101**	**446,252**	**446,950**	**492,114**	**504,248[b]**
World Total	**459,300**	**594,418**	**643,798**	**713,788**	**714,970[b]**

Sources: U.S. Bureau of Mines, World Bureau of Metal Statistics (London), and other sources.
Notes:
a. 1984 b. 1985 c. Rolled steel only
0 = zero or less than half of 1 percent; X = not available
For additional information, see Sources and Technical Notes.

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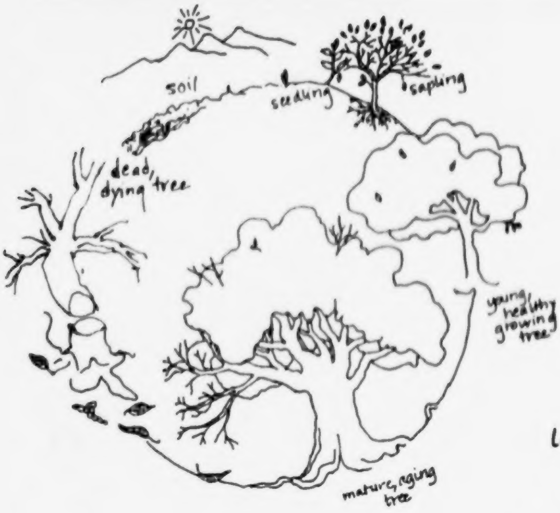
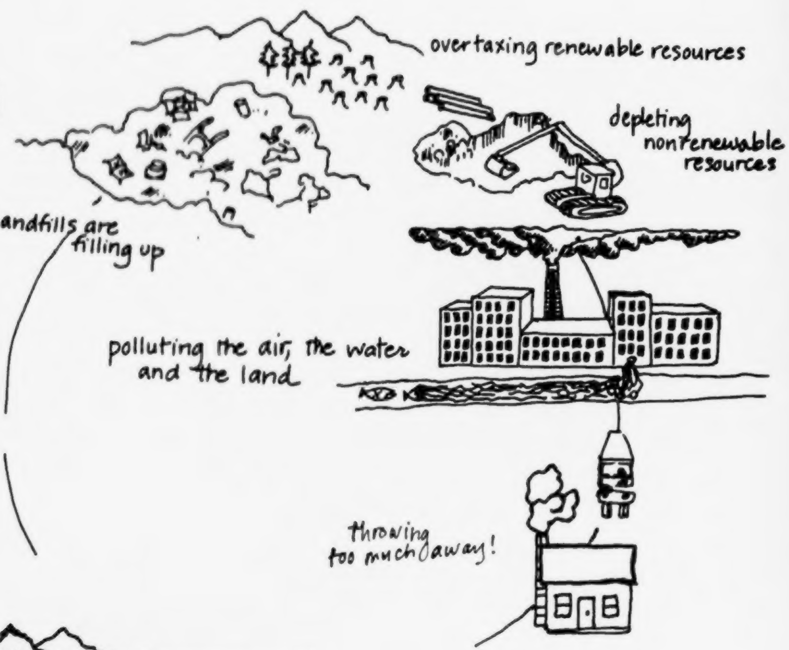
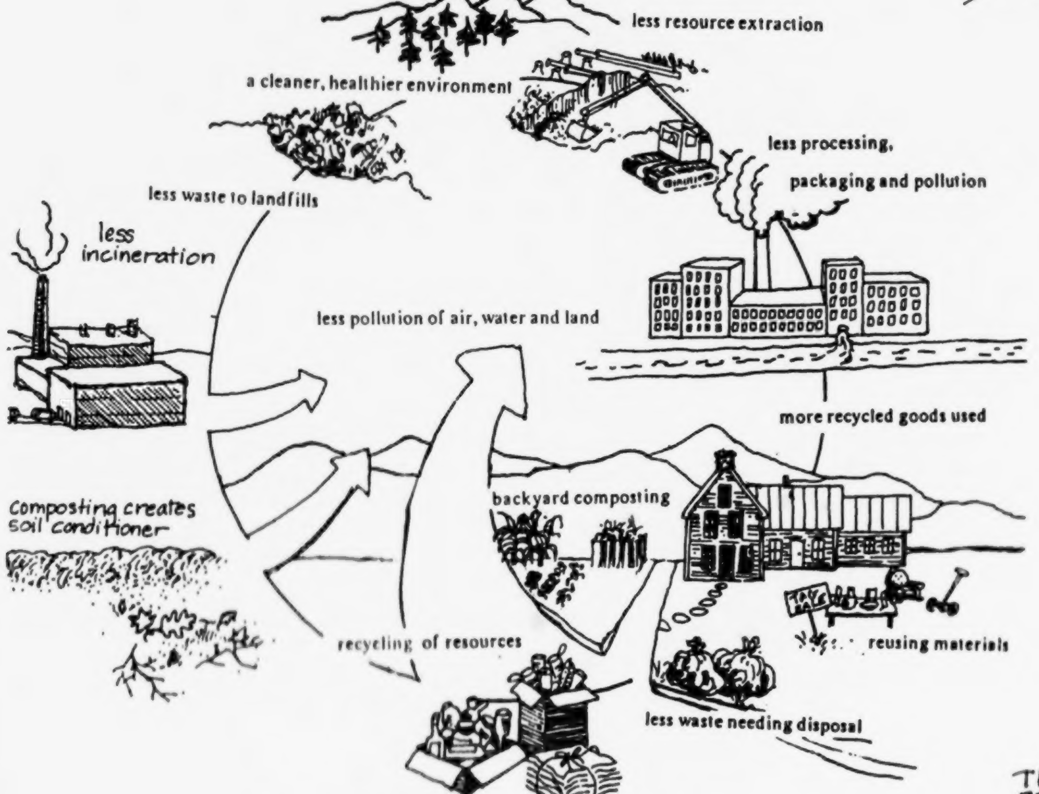


NATURAL CYCLES

HUMAN INTERVENTION


overtaxing renewable resources
depleting nonrenewable resources
landfills are filling up
polluting the air, the water and the land
throwing too much away!


less resource extraction
a cleaner, healthier environment
less processing, packaging and pollution
less waste to landfills
less incineration
less pollution of air, water and land
more recycled goods used
backyard composting
composting creates soil conditioner
recycling of resources
reusing materials
less waste needing disposal
separation of recyclables from waste

THE RECYCLING CYCLE

INFORMATION I.C.1 SHORT HISTORY OF TRASH

A VERY SHORT HISTORY OF TRASH

1 People have always had trash. Only Cavedwellers didn't have a big problem with it. In those days, there was plenty of room for trash. And nature easily disposed of it.

2 Today, trash is a big problem. More people mean more trash and more different kinds of trash. You name it — cans, paper, bottles, garbage, old cars, old clothes. In time it becomes T-R-A-S-H.

3 Every year, each one of us throws away almost ONE TON of trash. If you piled this trash in your living room, it would come to your shoulders.

4 In one year, all our trash amounts to 360,000,000 tons. We have problems with trash that Cavedwellers never had. To get rid of it, we have tried to...

5 ...burn it. But burning trash can cause air pollution.

6 ...dump it in the ocean. But dumping can pollute the ocean, too.

7 ...bury it. But we're running out of empty land near cities.

8 Some scientists have even suggested shooting it off into empty space. But who wants old tennis shoes and pop cans orbiting the earth?

9 In the past few years, however, we have found a new way to get rid of some of our trash. It's called RECYCLING.

Recycling means reusing our trash instead of getting rid of it. This solves the problem of what to do with our trash and it also helps us with another problem. By using the same materials over and over again, we save our natural resources.

Recycling means shredding old cans and cars and melting the pieces to make new metal for new cans and cars...

...chopping up grass cuttings and garbage to burn for energy or to make fertilizer to help new plants grow...

...crushing bottles into tiny glass bits and melting these bits to make new glass.

National Center for Appropriate Technology, Sophie Diven, illustrator.

* *Concept provided by McDonald's Corp.*

SOME NOTES ON THE HISTORY OF SOLID WASTE MANAGEMENT

"About 500 BC, Athens issued the first known edict against throwing garbage into the streets, and organized the first municipal dumps by requiring scavengers to dispose of wastes no less than one mile from the city walls. Like many Greek innovations, the practice of waste removal was lost in medieval Europe. Parisians continued to toss their trash out the window until the fourteenth century. Several hundred years later, as thousands of people thronged to newly industrializing cities to obtain factory jobs, they brought these practices with them and the garbage crisis multiplied. City governments ultimately adopted the responsibility for collecting and disposing of refuse.

Once the garbage was transported beyond the city gate, it was commonly dumped on scattered piles in the surrounding countryside. As cities grew, the available countryside shrank, and the noxious odors and rat infestations caused by the dumps became intolerable. Free-standing piles gave way to pits dug to confine the waste. In densely populated areas of Europe, even this disposal method was soon regarded as requiring too much space and posing an undue threat to groundwater, and a new solution was sought.

The first systematic incineration of municipal refuse was tested in Nottingham, England, in 1874. Burning reduces waste volumes by some 70 to 90 percent, depending on the contents, so waste commissioners on both sides of the Atlantic heralded the development. Densely populated and affluent cities soon built experimental incinerators, but many communities could not justify the expense. Large capital outlays for incinerators only made sense where cheap, unregulated waste burial sites were unavailable. Many cities that did hop on the incineration bandwagon soon jumped off when their air quality deteriorated. Waste burial continued as the most widely practiced disposal method."

(Cynthia Pollack, Worldwatch Paper 76, April, 1987, p.13,14)

"In the 1950's the amount of waste began skyrocketing because of new products, new packaging, and the type of packaging. Mixed material packaging which forestalls recycling became common and then the volume of the packaging expanded. In fact the expansion of the volume of packaging in the '50's led to abandoning the open trash pick up trucks which had facilitated recycling. What came about was a shift to garbage compaction trucks. And that was not enough. So they went to garbage transfer stations where the garbage from compaction trucks was compacted another time and put on trailers that hauled it to a landfill.

What we had along with this evolution in packaging was increasing capital costs for handling the wastes, resulting in increasing costs for dumping--and also reduced opportunities for recycling anything useful from the compacted trash."

(Neil Seldman, Interview in RE:SOURCES, Summer 1987, page 6)

INFORMATION I.C.2 TRASH TIMELINE

300 MILLION YEARS AGO WASPS ARE MAKING PAPER

250 MILLION YEARS AGO SWAMP PRECURSORS TO FOSSIL FUELS

2 1/2 MILLION YEARS AGO FIRST TOOLS MADE BY MAN

8,000 BC THE OLD STONE AGE ENDS ANIMALS ARE DOMESTICATED

BETWEEN 7 AND 8,000 BC GROUND AND POLISHED STONE AXES

BETWEEN 6 AND 7,000 BC FIRST USE OF NATIVE COPPER

AROUND 4,000 BC METEORIC IRON PROBABLY USED

4,000 BC WRITTEN HISTORY BEGINS

AROUND, AFTER 4,000 BC COPPER FIRST SMELTED

BETWEEN 3 AND 4,000 BC BRONZE FIRST SMELTED, BRONZE AGE BEGINS

3,000 BC METEORIC IRON IN EGYPTIAN PYRAMIDS

BETWEEN 2,000 AND 1,000 BC IRON FIRST SMELTED, IRON AGE BEGINS
GLASSBLOWING BEGINS IN NEAR EAST

AROUND 1,000 BC IRON BECOMES ABUNDANT IN EUROPE, NEAR EAST

500 BC ATHENS, GREECE ISSUES FIRST KNOWN EDICT AGAINST THROWING GARBAGE INTO THE STREETS, ORDERS WASTE TO BE DUMPED NO LESS THAN ONE MILE BEYOND CITY LIMITS

105 AD PAPER FIRST MADE IN CHINA

1035 AD PAPER WRAPPED VEGETABLES IN EUROPE

1041-9 MOVABLE TYPE INVENTED IN CHINA

1620 FIRST IRON FOUNDRY IN AMERICA

1690 FIRST PAPER COMMERCIALLY PRODUCED IN PHILADELPHIA

1709 ABRAHAM DARBY MAKING IRON USING COAL INSTEAD OF CHARCOAL

1739 FIRST SUCCESSFUL AMERICAN GLASS FOUNDRY IN SALEM, NJ

1769 JAMES WATT A MORE EFFICIENT STEAM ENGINE USING COAL

1790 PAPER FIRST MADE COMPLETELY FROM WOOD IN VERMONT

1806 FOUDRINIER MACHINE PRODUCING A CONTINUOUS ROLL OF PAPER PATENTED

1810 FIRST TIN-PLATED IRON CAN PATENTED AS FOOD CONTAINER IN ENGLAND

1818 TIN-PLATED CAN INTRODUCED IN AMERICA

1825 ALUMINUM FIRST ISOLATED FROM ORE

1844 VULCANIZATION PROCESS DISCOVERED BY CHARLES GOODYEAR

1849 PENDULUM PRESS PATENTED MAKING POSSIBLE CAN PRODUCTION INCREASES FROM FIVE OR SIX CANS PER HOUR TO 50 OR 60.

1859 FIRST IMPORTANT DISCOVERY OF OIL BY EDWIN DRAKE (lighting fuel)

1869 LITHOGRAPHY LABEL PRINTING PROCESS FOR CANS DEVELOPED

1874 FIRST SYSTEMATIC INCINERATION OF MUNICIPAL REFUSE TESTED IN NOTTINGHAM, ENGLAND.

1880-1890 AUTOMATIC CAN-MAKING MACHINERY

1886 CHARLES MARTIN HALL ISOLATES ALUMINUM THROUGH ELECTROLYSIS

1888 FIRST COMMERCIAL PRODUCTION OF PRIMARY ALUMINUM

1900 OLDS COMPANY BEGINS FIRST MASS PRODUCTION OF AUTOS

1903 WRIGHT BROTHER'S FIRST FLIGHT

1904 FIRST ALUMINUM RECYCLING BUSINESS FOUNDED

1906 RADIO TUBE INVENTED

INFORMATION I.C.2 TRASH TIMELINE

1908 OIL DISCOVERED IN MIDEAST
FIRST MODEL T FORD
ELECTRIC IRON AND TOASTER PATENTED

1909 FIRST PERMANENT WAVES IN HAIR SALONS
LEO BAEKELAND INVENTS BAKELITE

1910 FIRST COMMERCIAL PRODUCTION OF RAYON
ELECTRIC WASHING MACHINES MARKETED

1913 ALUMINUM FOIL FIRST PRODUCED

1914 CELLULOID ZIPPERS BECOME POPULAR

1915 ACTIVATED SLUDGE SEWAGE TREATMENT PROCESS DEVELOPED
FIRST TRANSCONTINENTAL PHONE CALL

1916 FIRST SANITARY LANDFILLS

1918 RUBBING ALCOHOL MADE FROM PETROLEUM

1921 RAYON BECOMES AN IMPORTANT FIBER

1923 BULLDOZER INVENTED
JACOB SCHICK PATENTS THE ELECTRIC RAZOR

1925 COMMERCIAL CHROME PLATING
FIRST AIR-CONDITIONED THEATRES
ELECTRIC COFFEE PERCOLATORS MARKETED

1928 FIRST SCHEDULED TV BROADCASTS

1931 NEOPRENE RUBBER
FIBERGLASS

1934 FIRST MAJOR LAUNDRY DETERGENT MARKETED

1935 FIRST FULL COLOR MOVIE

1938 NYLON FIRST SOLD AS TOOTHBRUSH BRISTLES
FLUORESCENT LAMPS MARKETED
POLYSTYRENE PLASTIC MARKETED
BALLPOINT PEN INVENTED

1939 DDT FOUND TO BE AN INSECTICIDE

1940 NYLON STOCKINGS WIDELY SOLD
FIRST REGULAR PASSENGER AIR SERVICE ACROSS THE ATLANTIC
NONTOXIC PIGMENTS REPLACE LEADS IN INTERIOR PAINTS

1941 AEROSOL SPRAY CANS INTRODUCED (with CFCs)

1943 POLYETHYLENE PLASTIC

1944 SILICONE RESINS MARKETED

1947 INSTANT PHOTOS INTRODUCED

1951 FIRST COMMERCIAL COLOR TV BROADCAST
FIRST MASS-PRODUCED COMPUTERS

1953 VERMONT PASSES THE FIRST CONTAINER LAW IN NATION
DETROIT'S FIRST ALL-FIBERGLASS CAR BODY
FIRST U.S.-MADE POLYESTER

1954 PLASTIC CONTACT LENSES INTRODUCED

1955 FIRST COMMERCIAL JET TRANSPORT

1957 FIRST ARTIFICIAL SATELLITE
FIRST U.S. COMMERCIAL NUCLEAR POWER PLANT
ALLUMINUM FIRST USED IN METAL CAN MAKING

1957 VERMONT'S FIRST CONTAINER LAW ALLOWED TO EXPIRE

I.C.2 TRASH TIMELINE

1959 FIRST XEROX MACHINE SOLD
SPANDEX ELASTIC FIRST SOLD

1960 OPEC FORMED
EASY-OPENING CANS INTRODUCED

1961 INTRODUCTION OF OLEFIN MAKES INDOOR-OUTDOOR CARPET POSSIBLE

1964 SWITCH TO BIODEGRADABLE DETERGENTS

1965 FIRST HOME VIDEOTAPE RECORDER
TIN-FREE STEEL CANS DEVELOPED

1969 FIRST MAN ON THE MOON

1970 (April 18) FIRST GREEN UP DAY
PEAK OF U.S. OIL PRODUCTION
NO-WAX VINYL FLOORING INTRODUCED
FEDERAL CLEAN AIR ACT

1971 OPEN DUMPS PROHIBITED IN VERMONT

1972 PASSAGE OF SECOND VERMONT CONTAINER DEPOSIT LAW
DDT BANNED IN THE U.S.

1973 VERMONT DEPOSIT LAW GOES INTO EFFECT
OIL EMBARGO/ EGYPTIAN-ISRAELI WAR --FIRST OIL PRICE SHOCK
FEDERAL CLEAN WATER ACT

1975 VERMONT BOTTLE BILL AMENDMENTS TO BAN DETACHABLE FLIPTOPS, NON-BIODEGRADABLE PLASTIC RINGS AND NON-REFILLABLE BOTTLES

1976 FEDERAL RESOURCE CONSERVATION AND RECOVERY ACT PASSED

1977 VERMONT BOTTLE BILL AMENDMENTS TAKE EFFECT

1978 FLUOROCARBONS BANNED AS AEROSOL PROPELLANTS
VERMONT LANDFILL REGULATIONS SET

1979 SECOND OIL PRICE SHOCK

1980 CERCLA

1984 AMENDMENTS TO SOLID WASTE BILL

1987 (June 2) SOLID WASTE BILL H.196 signed into PUBLIC LAW 78.

1988 (January) NEW SOLID WASTE MANAGEMENT RULES ADOPTED

1988 (April) FIRST PATENT ISSUED FOR A BIOLOGICALLY ENGINEERED ANIMAL

1988 (April) BOTTLE BILL EXPANDED TO ACCEPT LIQUOR BOTTLES AND WINE COOLERS

1988 (April) NEW SOLID WASTE MANAGEMENT PLAN OUT

1988 (June) FIVE NEW VERMONT SITES ADDED TO EPA SUPERFUND LIST

1988 (July 1) MUNICIPALITIES MUST JOIN REGIONAL GROUPS BY THIS DATE

1988 (December) STATE PURCHASING GOAL OF 15% RECYCLED MATERIALS

1989 (January) FIRST SET BIENNIAL REPORTS ON STATE PURCHASE OF RECYCLED MATERIAL AND WASTE REDUCTION

1990 (January) STATE REPORT ON HAZARDOUS WASTE MANAGEMENT AND DISPOSAL DUE

1990 (July 1) REGIONAL PLANNING COMMISSIONS ADOPT REGIONAL AND STATE PLANS, LANDFILL ASSESSMENTS COMPLETED BY ANR.

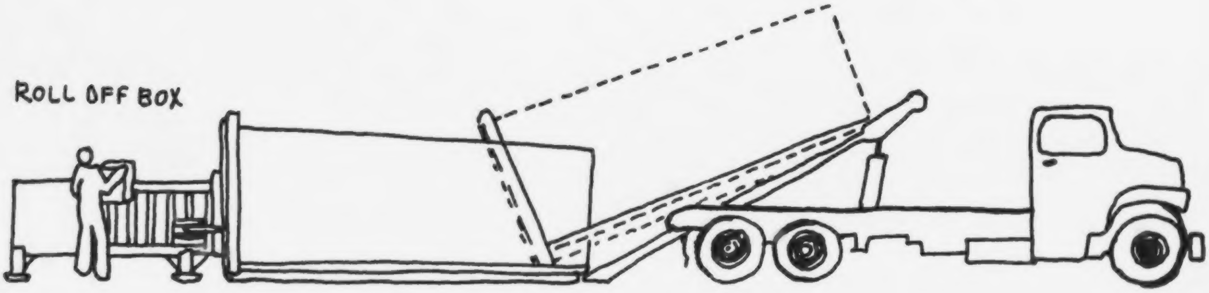
1990 (September 1) ALL VERMONT SOLID WASTE FACILITIES CERTIFIED OR CLOSED

1991 (January) SECOND SET BIENNIAL REPORTS ON PURCHASE OF RECYCLED MATERIAL AND WASTE REDUCTION

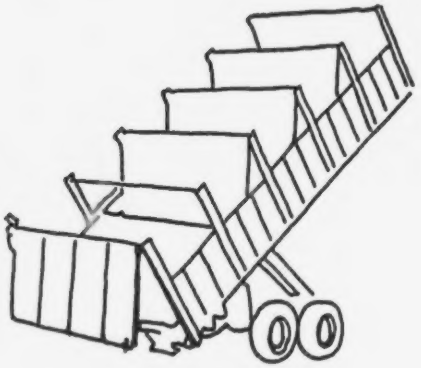
1991 (July 1) LINERS IN OPERATING PORTIONS OF ALL LANDFILLS

1993 (December) STATE PURCHASING GOAL OF 40% RECYCLED MATERIALS

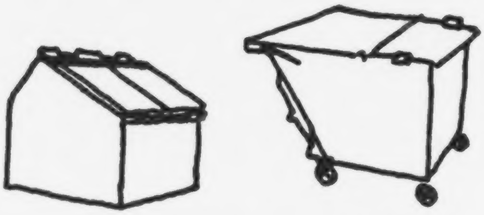
2000 STATE-WIDE REDUCTION/RECYCLING/COMPOSTING GOAL OF 40%



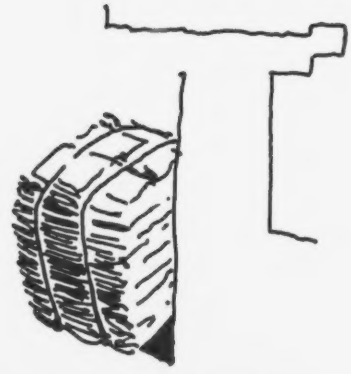
ROLL OFF BOX



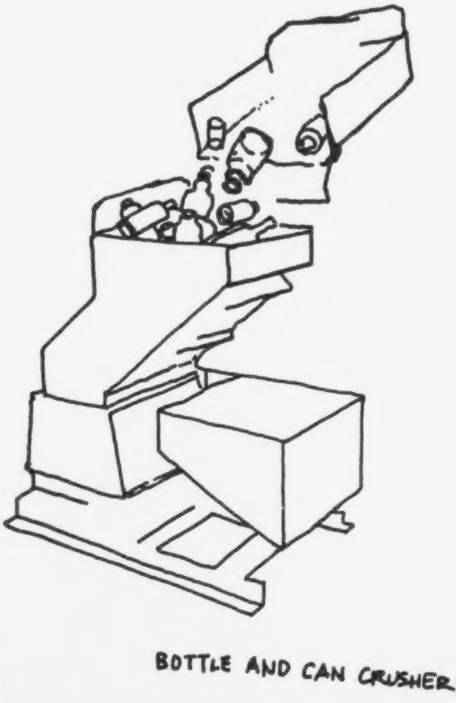
EAGER BEAVER



BINS and DUMPSTERS



PAPER BALERS



BOTTLE AND CAN CRUSHERS

INFORMATION II.A.2 TRANSFER STATIONS

Transfer stations are sites where municipal solid waste is collected (and may be compacted) to be transported elsewhere for incineration or landfilling. Often transfer stations are located at the closed "town dump" since the use of the site for waste handling is well established (and it would be difficult to establish a new site). The site is open regular hours, and is supervised. Individuals and haulers come, pay tipping fees, and deposit their waste in large containers (dumpsters and roll-off boxes). Many communities locate a recycling center at their transfer station, allowing persons to reduce their tipping fees by some amount for the waste they separate for recyling.

As of September 1987, there were 41 transfer stations operating in Vermont. Rutland County has the most transfer stations with 15 established in its 28 municipalities. Wastes from some of the stations in Vermont travel long (and costly) distances before final disposal. For example, wastes from Alburg travel some sixty miles one way to Moretown, Vermont; since the 1988 closing of the Vicon incinerator in Rutland City, Rutland County waste has been in some cases transported even farther in- and out-of-state.

(For a map and list of Vermont transfer stations see Resources Section A.4.)

INFORMATION II.A.3 LITTER

What is litter?

Litter is any waste which has been disposed of improperly or has escaped the waste-handling system. Most litter escapes from one of the following places: home trash cans, business and commercial trash cans and dumpsters, trucks, construction and demolition sites, loading docks and commercial storage areas, pedestrians, and motorists.

Why is litter a problem?

While litter is a problem for many reasons, the most obvious is its unsightliness. It spoils the beauty of our natural environment. Once we have covered a roadside or park with litter, we need to clean it up, a task which takes long hours and thousands of dollars. The Vermont Bottle Bill was passed in an effort to reduce litter. By offering a deposit on beverage containers, it gave people an incentive to return containers to stores instead of tossing them out car windows. Even those containers which were tossed were soon retrieved by entrepreneurs. The Bottle Bill worked very well, reducing the number of bottles and cans on Vermont highways by an estimated 90%.

Litter can also hurt people or other animals. For instance, an abandoned bottle could become a trap for an unsuspecting insect or rodent that cannot crawl out on the slippery glass sides. A broken bottle accidentally stepped upon could draw blood from people or animals.

What special problems does waterborne litter cause?

Most litter in our lakes and oceans at one time did not appear to be a problem because metal and glass sank immediately and paper products degraded quickly. Driftwood and "sea glass" even had aesthetic value. But with the introduction and growth of plastics in the last few decades has come a new problem, one which is highly visible and increasingly noticeable.

Plastic litter comes from ships and from sewage systems and industrial discharges. The fishing industry and pleasure boats discard nets, line, strapping, and consumer disposables. In addition, all plastic gadgets we use today, such as plastic bags, tablewares, cosmetic cases and brush bristles, are made from very tiny particles of virgin plastic which are melted and formed into any desired shaped. These little pellets or beads of raw plastic are then often lost in waterways during packing or shipping or in some cases are discharged directly into sewage systems and waterways from manufacturing plants.

How does plastic litter harm marine wildlife?

Marine mammals, reptiles, and birds can all be hurt by plastic litter in our seas, both from eating it and becoming entangled in it. Seals get discarded strapping bands caught around their necks and strangled. Turtles are often found with bags in their bellies, which they have presumably mistaken as jellyfish, one of their favorite foods. Little raw plastic nibs have been found in the stomachs of both fish and sea birds. Birds such as pelicans get entangled in fishing gear. Seagulls and fish are easily trapped in discarded six-pack rings. Plastic litter is a bigger threat to ocean wildlife, but atleast one drowned seagull has been found on Lake Champlain.

Sources: A Way With Waste; Center for Environmental Education.

VERMONT GREEN UP

BEAUTIFY

What Is Vermont Green Up

Green Up day is an annual event held the first Saturday in May. Green Up can occur at any time, at any place. The sole purpose of the organization is to promote the clean up of Vermonts natural resources. We need the interest, support and participation of all citizens to keep Vermont a clean, safe and beautiful place to live, visit and enjoy.

Since 1970 Vermont Green Up, Inc. has solicited the support of individuals, businesses, organizations and industry representatives to help maintain the aesthetic beauty of our Green Mountain State, Vermont.

Activities as simple as picking up trash on the road side, within and along our rivers, planting trees and providing flowers to enhance our rest areas has been occurring throughout the 19 years that Vermont Green Up has existed.

Green Up is a citizen-oriented endeavor, mindful of the dynamic nature of the natural resource challenges facing Vermont every day.

As president of the Vermont Green Up, Inc.'s Board of Directors I want to thank everyone who has assisted with the efforts of Greening Up Vermont over the last 19 years. The efforts both large and small have made a significant impact on the beauty of our state.

I encourage everyone to continue your efforts, involve more people, use the county contacts listed in this brochure and take pride in a job well done.

Leonard P. Perry

Leonard Perry, President

Green Up Poster Contest

All students, grades K-12, are eligible to submit one poster design for judging. Posters will be judged in four categories, K-3, 4-6, 7-9 and 10-12. An overall winning design will be chosen and used to promote **Green Up**. *The awards are: Overall Winner — $200.00, K-3, 4-6, 7-9 and 10-12 Winners $50.00 each.*

Rules for the Contest

1. *Any Vermont (K-12) student may submit one design.*
2. *All posters* **must** *be 11 inches wide by 14 inches high.*
3. *On the* **back** *of the poster, include:*
   - *a) Student's full name*
   - *b) Grade*
   - *c) School name, address and* **county**
   - *d) Teacher's full name*

Practical Pointers

- — *Creative ideas and brief slogans regarding the Green Up concept are encouraged.*
- — *White paper is preferred.*
- — *Bright, contrasting colors are desirable—* **avoid crayons, pastels or fluorescent colors.**
- — *The winning poster will be reproduced in full color.*
- — *Judging will be based on a determination of: originality, Visual Simplicity, Clarity of Message and Visual Impact from a Distance.*

How You Can Help

Green Up can include any number of activities. Here's a brief list to help spark some ideas:

Green Up—
- *Plant and care for trees, flowers, shrubs*
- *In town—parks, traffic circles and islands*
- *At rest areas*
- *At home*
- *At hospitals, nursing homes*

Clean Up—
- *Pick up trash—*
  - *Along roadside, turnouts, rest areas*
  - *Along rivers and streams — access areas*
  - *In town — streets and parks*
  - *Hiking trails, parks and woodlands*
  - *Contact State Park Managers*

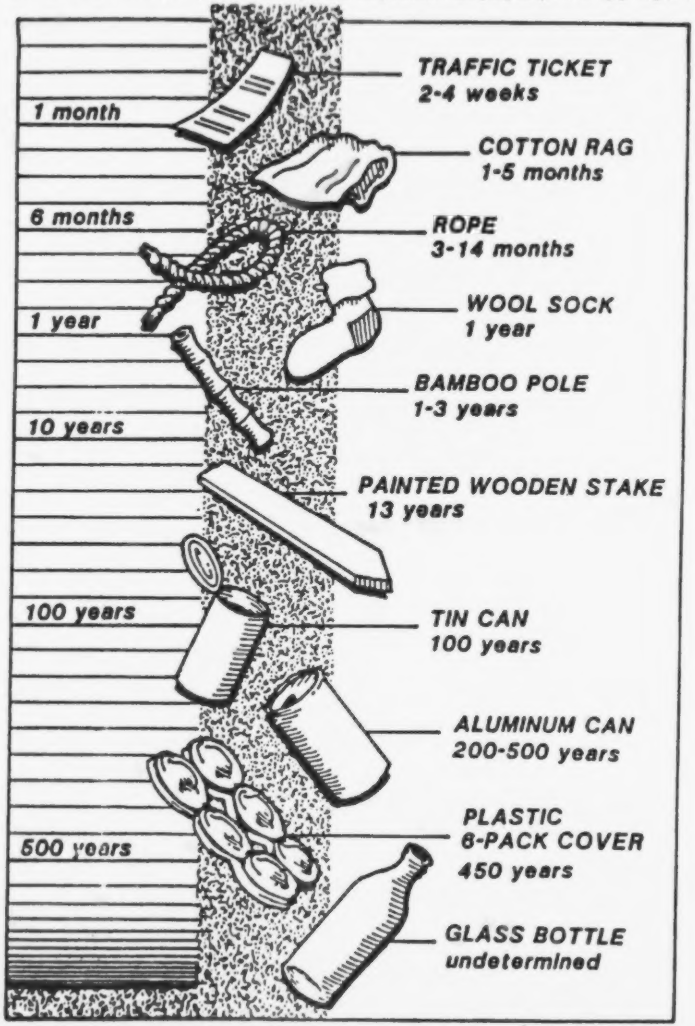
Paint Up, Fix Up—Spruce Up most anything

Vermont Green Up, Inc.
P.O. Box 1191
Montpelier, Vermont 05602
Tel. 802-229-4586

The Green Up flag.

Enduring Litter

Litter at the roadside is ugly. How long it will stay before decaying may be an ugly surprise.



Source: Book of Lists 2

The history of incineration

The first municipal incinerator was designed and built in England more than a century ago. It seemed to be a simple, efficient and sanitary way to dispose of garbage. Burning garbage eliminated the need for transporting waste from cities, saved space in dumps, and destroyed many disease-causing microorganisms and viruses. The technology was soon imported to this country, and by the 1920's there were more than 300 incinerators in use.

The first incinerators burned trash without worrying about what was coming out of their smokestacks. As concern rose over the quality of our air and legislation was introduced to prevent further air pollution, their use declined, since the cost of pollution control equipment made it cheaper to landfill waste. (Landfills currently accept 90% of our nation's waste.)

Technology was then developed to absorb some of the heat from waste incineration, turning water to steam which could then be used to generate electricity. This process lowered the temperature of incinerator exhaust to within the range of temperatures where proven emission control equipment could effectively operate. Thus this technology made possible the installation of pollution control equipment in incinerators, while its ability to generate power helped offset some of the high cost of such equipment. With landfills filling up, this new technology, called with varying degrees of precision "waste-to-energy," "energy recovery," and "resource recovery," led to a renewal of incinerator popularity in the 1970s.

Today's waste-to-energy plants can reduce up to 90% of the volume of waste requiring disposal and can be designed to process from 100 to over 3,000 tons of refuse daily. At the same time, they produce steam or electricity which can satisfy a portion of local energy needs. The waste-to-energy plant in Claremont, NH for instance, with a daily intake of 160 tons of refuse, produces enough electricity to provide about 20% of Claremont's energy needs.

The number of incinerators is increasing. There are currently over 75 waste-to-energy incinerators operating in the United States with over 140 more under construction or planned. The Wheelabrator plant in Claremont is one small mass-burn facility serving 13 southern Vermont and 15 New Hampshire communities. A 250 ton-per-day mass-burn plant in Rutland, which closed due to bankruptcy in 1988, may in the future resume operations serving the region.

How do incinerators work?

Incinerators burn waste to reduce its volume. Incinerators can burn unprocessed waste (mass burn) or processed waste ("refuse derived fuel") and can be equipped to generate energy. Incinerators so equipped use the heat from burning garbage to turn water to steam, which is then either fed into a steam-loop or district heating system or used to turn turbines at the incinerator to generate electricity.

Mass-burn facilities are seemingly convenient from a solid waste management perspective. There is no pre-processing of waste, and no changes must be made in the way most municipalities presently collect their trash. When trucks enter a waste-to-energy facility, their loads are weighed, and the trash is delivered to a tipping platform. Front-end loaders and cranes are used to push the waste down a shoot (hopper), from where it is fed into the combustion chamber. The residual ash from the combustion chamber (bottom ash) and that collected by pollution control equipment (fly ash) is deposited into large covered dumpsters which are hauled away to a lined landfill.

Incinerators require a steady flow of waste and need to maintain a steady temperature in burning. Noncombustibles in the waste stream such as glass and metal inhibit efficient burning as do kitchen wastes, leaves and grass because of their high moisture content (30-75%) and low BTU value. Increasing amounts of petroleum-base plastic, with a high BTU value, in the waste stream also affect burning. In order to maintain a consistent temperature, incinerator operators must regulate a changing solid waste composition, the amount of trash fed into the plant, how the system is started up and shut down, and other variables that change burning temperatures.

How does incinerator pollution control equipment work?

The Clean Air Act, passed in 1970, limits the emission into the air of seven major classes of pollutants: particulates, sulfur dioxide, carbon monoxide, ozone, hydrocarbons, nitrogen dioxide, and lead. This legislation put an end to incinerators without pollution control devices, as well as routine uncontrolled burning at open dumps. Pollution control devices are now required on incinerators to remove particulates, acid gas, and toxic compounds created in burning solid waste. Any incinerator that operates in Vermont will have to comply with strict air pollution control regulations for its exhaust.

Pollution control in a state-of-the-art incinerator consists of temperature controls, "dry" or "wet" "scrubbers," and "baghouses." To receive an operating license in Vermont, an incinerator must have in place all of these controls. Temperature controls involve first and foremost efficient combustion between 1500 to 1800 degrees Farenheit of all waste, eliminating most particulate matter. Second, exhaust gases are carefully "co-aired" or cooled to precipitate out any dangerous vaporizing metals, such as lead and mercury. "Scrubbers" then use reagents (like lime) to neutralize acid gases. Finally a "baghouse," essentially a fine mesh filtering system which works something like a vacuum cleaner bag, strains out particulates (including the precipitated metals) from the exhaust gases. Together these controls eliminate most all, but not quite all, particulates and acid gases from incinerator emissions. In Vermont these emissions are to be continuously tested to see that all particulates and gases are within levels permitted by the U.S. Environmental Protection Agency and the Vermont Agency of Natural Resources.

What happens to incinerator ash?

In most cases both "bottom ash" from the combustion chamber and the generally more toxic "fly ash" collected by a "baghouse" are combined for disposal and sent to double-lined landfills. In Vermont the "EP toxicity leaching test" is used before transport of ash to test its potential for leaching metals in mixed solid waste landfills. Variations above and below "regulatory thresholds" for toxic metals such as lead and cadmium have been recorded for the ash from incinerators serving Vermont, but this is of less concern since the ash is disposed of only in leachate-controlled landfills. (Leachate is collected in pipes, located above the liners at the bottom of the landfill, which empty into a holding tank, the contents of which are then taken to a waste water treatment plant for final treatment.)

The ash produced by the Claremont incinerator is sent to a double-lined landfill in Newport, N.H. The future of ash from the Rutland incinerator is uncertain. Should the plant reopen, there have been discussions of using some portions of the ash as aggregate with cement to produce concrete blocks that may be more easily stored and transported (further research on this process would be necessary before it is permitted).

What are the benefits of incinerators?
Incinerating solid waste can reduce the volume of trash going to a landfill by up to 90%, resulting in a 60-70% reduction overall in landfill demand. By doing this incineration in effect helps conserve land and protect water sources from contamination. Incineration also destroys potentially disease-causing organisms in solid waste and helps keep them out of landfills. Finally, incineration destroys a number of chemicals and toxic compounds, such as pesticides, that are a major source of contamination at existing landfills. Dioxins are both created and destroyed in the incinerator combustion process, and some data indicate that resulting dioxin levels may be reduced overall from that found in incoming solid waste.

What is the debate over incinerator safety?

There is much public debate about the safety of incinerators concerning their emissions and disposal of their ash. Proponents of incineration maintain that the toxicity of emissions and ash are well within levels determined safe by state and federal regulators, and most often, in fact, are substantially below levels that should be of remote concern. They also point out that incineration may actually reduce the amount and leachability of toxic substances that would otherwise be landfilled. Opponents of incineration maintain that some potentially dangerous emissions or leachables are not tested for or regulated, and many of those that are are permited at levels of exposure that have not been proven safe or are, at least, open to question. They also note that incinerators concentrate toxic materials in their ash, compounding the problems of landfills and any accidents in handling the ash.

At base the incinerator safety debate is one of whether it is safe to procede with incinerating waste on the basis of what we know. Proponents say that based on what we know scientifically about the potential risks of incineration and landfilling its ash, there appears to be no significant public health threat. Opponents say that despite some studies, we know too little about the effects of long-term, low-level exposure to some of the byproducts of incineration and that until we know more we should not take a chance with public health. In the last analysis this debate becomes social rather than technical in nature, a question of faith in technology and the limits of human ability to safely intervene in the environment. Whether incinerators operate in a given community or not ultimately will be determined by political and economic factors.

What are some problems of incinerators?

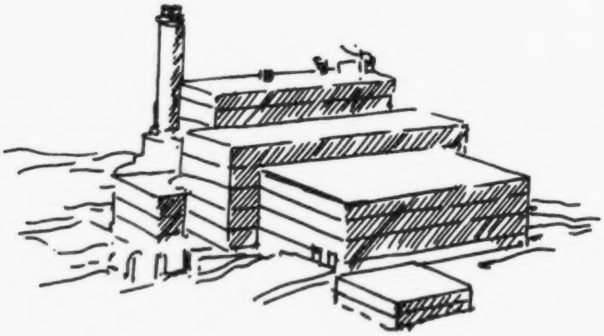
Incinerators share many of the problems of any waste management facility (such as landfills and recycling centers), including truck traffic and associated noise and litter. However since operations take place within an enclosed structure at an incinerator, problems such as litter, odors, and insect and rodent infestation are better controlled than, say, at a landfill.

Incinerators are expensive, capital-intensive items to invest in, operate and maintain, making it most economical to build large plants so that costs per ton of waste accepted are lower. However, large sums of money must be borrowed to construct an incinerator, and whether the plant is running at half or full capacity, the agreed upon schedule of payments must be met. Hence, although larger plants may be more economical, oversizing a plant can be very expensive and actually can create something of a "demand" for waste, something contrary to waste management goals. Facilities are perhaps best undersized but designed with space to add an additional incinerator unit should it be needed (the Claremont incinerator is so designed).

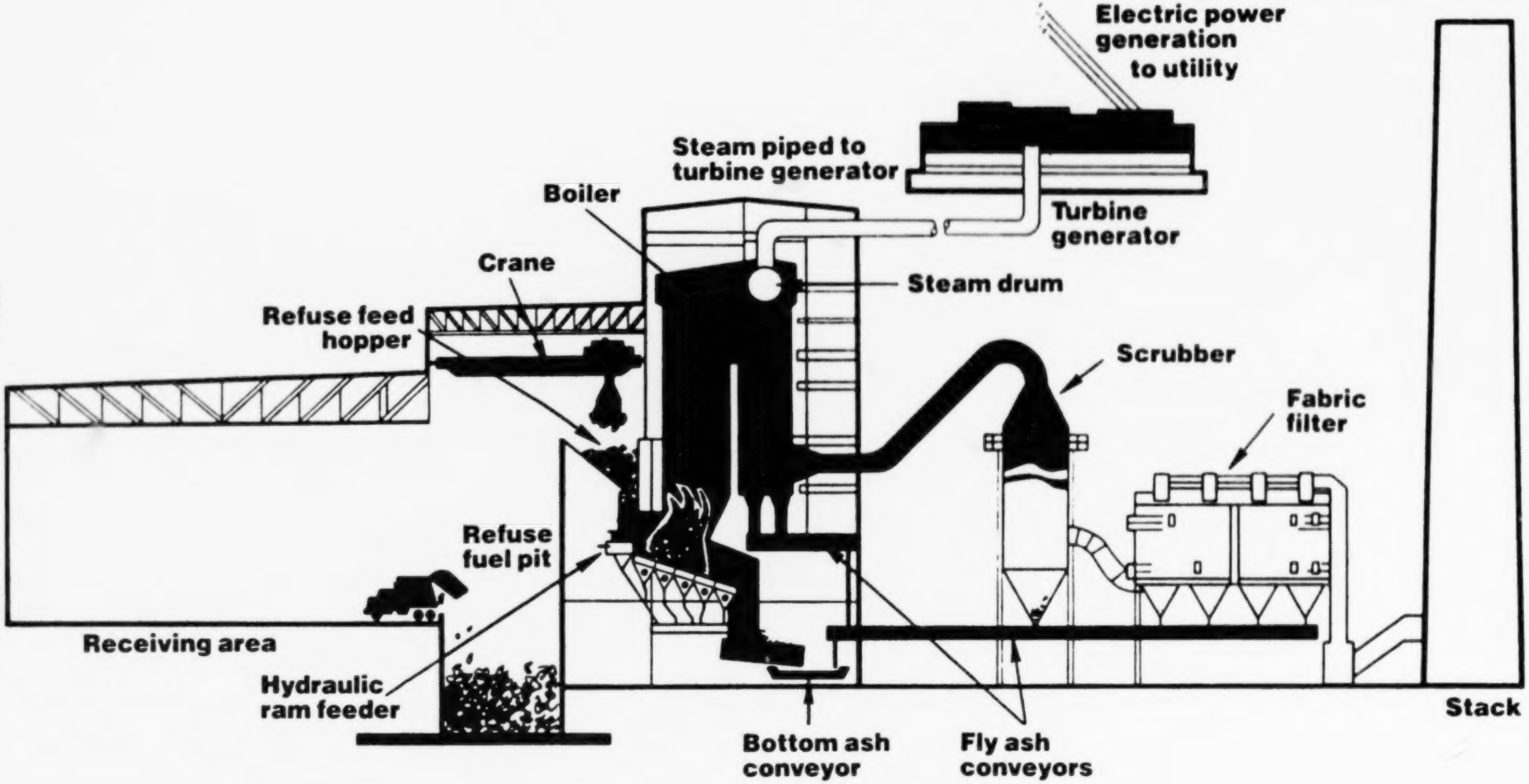
Although influential groups such as banks and construction companies may strongly support constructing incinerators, once constructed the uncertainties of future government regulation and vocal opposition and legal challenges to any incinerator have the potential to greatly increase the cost to its investors and users. Regulation may affect both the ability of a plant to operate at full capacity (and hence economically) and may increase the cost of disposing of its ash (e.g. if ash were to be classified as hazardous waste, as is sought by some). Although revenues from power generation may in part offset a fraction of incinerator costs, these revenues have proved quite variable as utilities have negotiated and public service boards determined the rate that an incinerator receives for its power. Like other waste management options, incinerators will be successfully operated only to the extent that they avoid the costs of alternate disposal means and associated environmental problems.

Finally, incinerators can be only as safe as the waste that society produces which is fed into them. Whatever other safety problems there may be, incinerators and their ash will be safest if nothing toxic (e.g. batteries, waste oil), nothing recyclable (metals, plastics, glass, paper), and nothing compostable (food and yard waste) goes into them. An incinerator burning only mixed waste from which these items have been removed as thoroughly as practicable will minimize any potential burning, pollution control and mechancial problems of incinerator technology.

Sources: *Wastewise* ; Pollack,1987; Natural Resources Defense Council, March 1988; State of Vermont Solid Waste Management Plan - 1988.



Hershkowitz, Allen. "Burning Trash: How It Could Work." *Technology Review.* 90:26-34 July 1987.



Above: How a waste-to-energy plant works. Lime sprayed into the scrubber neutralizes acid gases that would otherwise contribute to acid rain. The scrubber also helps control dioxins and toxic metals emitted during burning. These pollutants are adsorbed onto fly ash—the ash carried out of the furnace by exhaust gases. A fabric filter collects the fly ash, which must be dumped in secure landfills so that it does not contaminate groundwater. The bottom ash, another residue of the burning process, is not as dangerous.

THE OLD TOWN DUMP

"Once upon a time, every community had a dump. The dumps were not very expensive to operate since the only thing they consisted of was a steep bank located near a road, sometimes near a river. The dump was occasionally burned and then covered with soil. That way the bank was extended, and the dump could continue to operate for several years. Rats and other scavengers eliminated the food wastes, and people picked a lot of other things that other people threw away. The system of local dumps performed a valuable function. To be sure, smoke, polluted water run-off, and noxious odors did cause some health problems, but there were not a great many environmentally-concerned citizens clamoring to improve the situation. Eventually, however, concerns grew about the impact of dumping things like lead-based paints, used motor oil, and lead/acid car batteries over the bank, and pressures mounted to do something about the dumps." (Richard Cate, "Government Versus Garbage", { Vermont Affairs } Winter 1988.)

LANDFILLS OF THE 1970s

In 1968 Vermont passed its first law requiring municipalities to provide for proper waste disposal, effectively putting an end to open dumps. Requirements for regularly covering waste with fill and a prohibition on burning greatly increased the cost and decreased the capacity of the existing disposal sites, renamed landfills. These costs made larger private or municipal landfills more economical than individual town landfills, and the number of land waste-disposal sites dropped steadily between 1969 and 1985 from over two hundred to about seventy. During this same period it became apparent that even most of these landfills were sited in places or operated in ways that endangered groundwater (due to seepage of waste-contaminated rainwater through the landfill). In 1987 a new Vermont solid waste law, Act 78, mandated that by July 1, 1991 all landfills, new and old, be lined. (Existing landfills permitted prior to the effective date of Act 78 that receive less than 1000 tons of waste per year are exempt from this requirement if they comply with strict environmental monitoring.) Thus by 1991 a new generation of lined landfills, comprised of new landfills or expansions of existing landfills, must be developed.

NEW SANITARY LANDFILLS

In January 1989 the new State Solid Waste Management Plan and Solid Waste Rules developed by the Vermont Department of Environmental Conservation were approved. The Solid Waste Management Plan mandates that the State do preliminary hydrogeologic testing and Regions do follow-up testing of potential and existing landfill sites to determine their suitability for lined landfills. This means that the bedrock and surface geology of a site will be tested to see that any leaks from a landfill will not contaminate ground or surface water. The Solid Waste Rules will ensure the following about new sanitary landfills:

1. Opening burning is not allowed (except for untreated wood).
2. Wastes are spread out and compacted.
3. Solid waste must be covered daily with several inches of soil.
4. Pollution of ground and surface water must be prevented through the use of synthetic or compacted clay liners and systems that collect rainwater that has seeped through the landfill (leachate). This leachate will then be tested to see if it may be treated in a waste-water treatment plant or must be disposed of in a manner similar to hazardous liquid wastes.
5. Litter must be controlled.
6. Roads have to be strong enough to carry heavy waste hauling equipment and vehicles.
7. Fencing and a lockable gate are required to prevent illegal dumping.

8. Dust must be controlled.
9. Rodents and insects must be controlled to protect public health.
10. When portions of the site are full, they must be covered with a thicker layer of soil and landscaped.
11. Provisions must be made for the safe escape of methane gas generated by the decomposition of organic material in the landfill.

LANDFILLS AND GROUNDWATER

What is groundwater?

Groundwater is precipitation which has worked its way down from the surface to the water table or aquifer. The water table is the point at which this water saturates the soil or fractured bedrock. The size of any given aquifer varies with the area's geologic conditions. Water can move easily through or saturate sand and gravel, but does not flow through silts and clays as easily. The amount of water in bedrock will depend on the number of cracks and fissures in the rock which will allow the water to flow freely. It is important to consider the geology of an area very carefully when looking for a site for a new landfill. Soils which easily transport water must be avoided.

How is groundwater replenished?

Recharge areas are places where soils absorb rainwater and runoff allowing it to seep down to the aquifer. Once there, the water begins to move slowly through the water table to a discharge area - a stream or swamp, pond or lake, a natural spring or constructed well. Water moves very slowly underground, but it can travel a long way from its recharge area before it is discharged to the surface again. Landfills must be sited away from recharge areas and the natural flow of water must be mapped.

What is leachate?

Leachate is water which has percolated down through a substance, picking up chemicals or organic matter as it goes. The particles become dissolved in the water and move with it, running off into streams or seeping down to contaminate the aquifer. When it rains on a landfill, the passing water can pick up many of the components of our solid waste. Hazardous wastes such as used motor oil, paint products, cleaners and batteries all contain elements which add to leachate. As other wastes decompose, additional hazardous substances may be produced and picked up by leachate. Fortunately the concentration of hazardous substances in leachate is greatest during the first years after waste is buried and rapidly becomes less and less over time; this is why liners for landfills that do not accept hazardous wastes do not need to last forever.

At a lined landfill, leachate is collected in pipes located above the liners at the bottom of the landfill. The leachate is pumped through the pipes to a holding tank and then pumped out of the tank when it is full. It is then transported to a wastewater treatment plant for final treatment, similar to any discharge from industries that generate water wastes.

How can we protect groundwater?

About 40% of the drinking water in the northeast comes from groundwater. Once contaminated, groundwater sources are extremely difficult if not impossible to clean. There are many contaminated sites in Vermont, many of which are landfills, which must now be cleaned. Just about every existing landfill is releasing leachate into our environment presently or will do so as time goes on.

It is very important to prevent additional contamination. The first step is to reduce, as much as possible, problem-causing materials from entering the waste stream that goes to the landfill. Thesecond is to prevent the spread of these materials to groundwater by siting landfills in a correct hydrogeologic area, installing lining and leachate collection devices, and then properly testing, treating, neutralizing and/or storing the leachate collected. The third is to set up careful monitoring systems to make sure that preventative measures are working and that groundwater is not being contaminated.

LANDFILLS AND METHANE

What is methane and why is it a problem?

Another by-product of the decomposition of buried solid waste is methane. Carbon dioxide, methane, ammonia, and sulfur gases are all produced as microorganisms break down these wastes. Trapped beneath the landfill surface, these toxic gases are potential health and safety threats. Unexpected explosions and underground fires are common. Methane will also move laterally beneath the surface of the landfill, threatening adjoining land and homes where the flammable gas can resurface, polluting air and threatening additional explosions. To prevent these problems, vents are installed in the landfill to reduce the pressure build-up of the gases and allow their safe escape.

Can we use methane as a fuel?

Methane is the largest component of natural gas, a commonly used fuel. If the volume of the landfill is at least one million tons, the methane produced can be captured, purified by removing carbon dioxide and water, and sold to gas utility supplies. As with recycling, the production of methane may not represent a profit, but it can help subsidize the operating costs of the landfill.

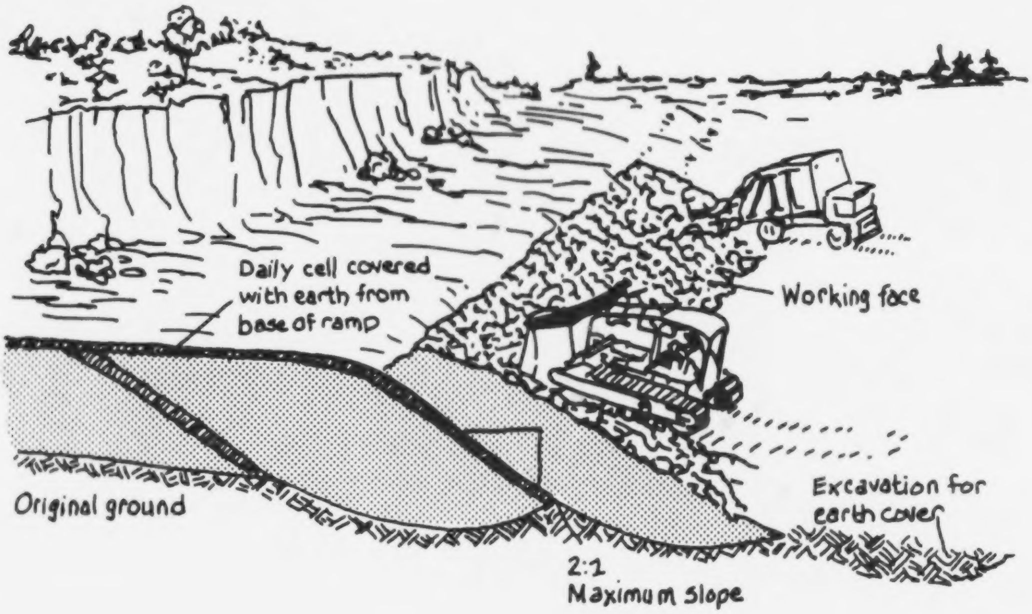
There are at least forty methane recovery systems operating or under construction in the United States, and at least one thousand landfills large enough to handle a methane recovery system. The largest methane recovery system is installed at Fresh Kills, New York, the largest landfill in the world. Five million cubic feet of gas, enough to heat 50,000 homes, is produced there daily. The landfill in Brattleboro, Vermont collects its vented methane and uses it as an energy source.

OTHER PROBLEMS WITH LANDFILLS

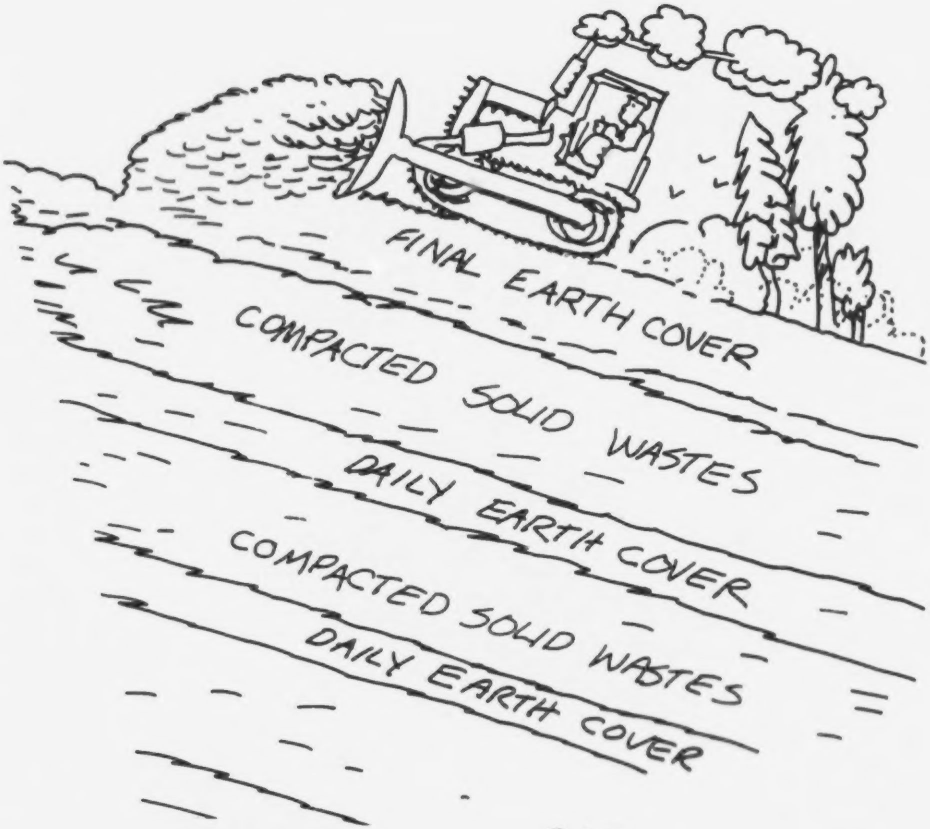
Landfills, like most waste management facilities, generate a great deal of truck traffic, noise, and litter. They also attract rodents, gulls, and other pests, and have dust and odor problems. Although studies indicate that the value of properties more than one thousand feet from a landfill are unaffected by its presence, nobody wants a landfill anywhere near their home ("Not in my backyard!"), so new landfills are politcally very difficult to site and open. In addition regulations regarding the placement of new landfills have become more strict, and with growth and development there are always less and less new suitable sites.

However, old landfills are filling up and must be closed to protect the environment. As they fill up, many towns must send their waste farther and farther away from its source. This costs more and more money; in New York City and Philadelphia disposal costs are nearing $100/ton. Despite any potential problems, landfills are needed because once we have reduced, reused, recycled and composted as much of the waste stream as we can, there are no other more environmentally sound options for disposing of waste.

Sources: Purcell, Arthur. *The Waste Watchers*; Pringle, Lawrence. *Throwing Things Away*; *Waste-Wise;* Vermont Solid Waste Management Plan-1988.



Daily cell covered with earth from base of ramp
Working face
Original ground
Excavation for earth cover
2:1 Maximum slope



FINAL EARTH COVER
COMPACTED SOLID WASTES
DAILY EARTH COVER
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DAILY EARTH COVER

LANDFILL FACTS

- Approximately 90% of the nation's waste is disposed of in landfills.
- Landfill problems are the worst in the northeast and central states where populations are high and land limited.
- Before 1980, there were no federal regulations on the construction of landfills, and little control over what went into them.
- Of the 9,284 municipal landfills in the U.S., only 59% have permits or approved plans for operating. Of these, only 15% have liners to channel toxic leachate. (Herschkowitz, 1987. Garbarge Burning, p.2)
- In the late 1960's, 90 percent of all U.S. landfills were open dumps. (Enterprise for Education; Hazardous Waste From Home)
- In 1970, there were approximately 200 open dumps in Vermont which burned refuse regularly.
- In 1972, there were 116 landfills operating in Vermont; by 1985, this number had dropped to 72; by 1990, the number of landfills is estimated to fall to 50 or less. (ANR)
- As many as 25 states still lack federally approved solid waste management plans.
- According to (RE:SOURCES 1986) there are 16,141 landfills across the nation: 9,113 municipal, 2,555 demolition debris dumps 1,027 other including 838 illegal open dumps, and 3,446 industrial landfills.
- In 1986, 296,000 out of 356,000 tons (approximately 80%) of solid waste produced in Vermont was landfilled.
- Each ton of waste consumes about 50 cubic feet of landfill space. (DEQ re:think recycling)
- The EPA estimates that 27 out of 50 states will run out of room to dump their garbage by the year 1990.
- At least 180 of the 888 worst superfund sites are municipal landfills. (May 11, 1987 US News and World Report)
- "The Environmental Protection Agency's Office of Solid Waste has estimated that an average land disposal site, 17 acres in size, with an annual infiltration of ten inches of water, can generate 4.6 million gallons of leachate a year." (Michael Brown, p. 106, Laying Waste.)
- Fresh Kills Landfill on Staten Island, New York, discharges 4 million gallons of toxic leachate each day. (Science 12 June 1987 p.1409)
- It is estimated that only one of the existing 64 landfills operating in Vermont in 1988 will still be in operation in 1991.

Copies of the law are available from the Agency of Natural Resources.

POLICY AND PURPOSE

To provide state leadership through technical and financial assistance to promote reduction, reuse, and recycling of wastes.

To ensure that all generators of waste pay the real costs to society of waste management.

To develop a waste management program which is sustainable, environmentally sound, and economically beneficial over the long term.

To prioritize waste management activities in the following order:

1. Reduction of the amount of waste generated;
2. Reuse and recycling of materials;
3. Processing of wastes to reduce volume before disposal; and
4. Land disposal of residuals.

PLANNING

State Waste Management Plan

The Plan must be based on the priorities specified above. In addition, the new statute requires that preference be given to disposal and processing alternatives which do not foreclose waste reduction and recycling, and that alternatives should be examined in terms of their total life-cycle costs. The Plan must be revised every five years.

The Plan must specify methods to divert materials from the waste stream. Management strategies must also be specified for problem wastes like tires, batteries, and unregulated hazardous wastes. It will contain assessments as to the volume, sources, and nature of Vermont wastes; their current fate; the feasability and cost of recycling different waste types; and a survey of the markets for recycled materials. Strategies to ensure that materials are recycled must also be included.

The Plan will include proposals for facilities and programs at the state, regional and local levels that will achieve the above priorities.

Finally, the Plan will include an assessment of the status, capacity, and life expectancy of existing facilities. For new facilities, siting requirements and requirements for public participation must be specified.

Local/Regional Waste Management Plans

Each municipality must join or participate in a regional planning commission's or solid waste management district's planning efforts by July 1, 1988.

Municipalities who are not participating in regional planning efforts as defined in the statute by the above date will not be eligible for financial assistance and will not be able to use certified regional facilities.

Regional Planning Commissions must adopt a utility and facility element, 24 V.S.A. 4348 (b) (4), which incorporates the plans of solid waste management districts within their bounds, by July 1, 1990. Both district plans and utility and facility elements must conform with the State Waste Management Plan.

Waste management contracts drawn up before January 1, 1987 which are inconsistent with the State Waste Management Plan need not be breached so long as good faith efforts to renegotiate the contracts have been made.

Planning Grants

Up to 100% of the regional planning commission's or solid waste district's eligible planning costs may be paid by the Agency for Development and Community Affairs if the proposed planning process is approved by the Agency of Natural Resources. 75% of the grant is available initially; the remaining 25% may be paid out when a plan has been adopted by the commission or district, reviewed by the Agency of Natural Resources, and after an audit is completed. A maximum $5,000 advance is available per district or commission.

Technical Advisory Committee

A ten member advisory committee will be appointed by the Governor from affected businesses, local government, and the general public. The advisory committee will be consulted by the state on the state waste management plan, state-sponsored facilities, grant/loan proposals, facility standards, and product taxes or bans.

Reporting Requirements/Public Hearings

The Secretary of the Agency of Natural Resources must hold public hearings, perform analyses, and report to the general assembly and the governor on: 1. hazardous waste in Vermont (by January 1, 1990) and 2. waste reduction (in January of every other year).

The purchasing director must aim to purchase 15% recycled materials by 1988 and 40% by 1993. In January of every other year, the purchasing director shall report to the Governor and to the general assembly.

FINANCIAL ASSISTANCE

In addition to the planning grants described above, implementation grants and loans are also available through the Department of Development and Community Affairs.

Up to 40% grants are available for construction of a waste management facility or purchase of equipment for the facility, provided that the facility: 1. is included in the areas's plan and is consistent with the state plan, and 2. is not a sanitary landfill or incinerator. Grants are also available for closure of an existing facility.

A low interest loan fund will be established to assist in costs related to the construction of a waste management facility or purchase of equipment for the facility (excluding sanitary landfills or incinerators) and for closure of an existing facility, provided it is included in the area's plan and is consistent with the state plan.

FUNDING

Solid Waste Management Assistance Fund

A fund is created, consisting of the receipts from the landfill surcharge (franchise tax) and state appropriations. It may be used by the state for planning, design or construction costs for state or regional recycling facilities; for the cot of preparing the state waste management plan; for the cost of a hazardous waste pilot project; for secondary materials (recyclables) market development; and for administrative functions. The state may also use the fund for landfill assessment costs, or for closure of existing facilities.

Franchise Tax on Waste Facilities

A franchise tax or surcharge is imposed on waste management facility operators in the amount of $2.40 per cubic yard (or $6.00 per ton if requested) of waste materials delivered to the facility. The tax is due quarterly.

Effective date: July 1, 1987 for privately owned or operated facilities; July 1, 1988 for municipally owned and operated facilities. Municipally owned facilities which are privately operated are subject to the tax on July 1, 1987.

Municipal operators may pay $3.50 per person instead of the above rates. Municipally owned and operated facilities may retain 5% of the tax to defray administrative costs.

Exemptions: wastes delivered to recycling facilities; ash from an incinerator constructed after January 1, 1987 (ash from Rutland's Vicon plant will be taxable where it is disposed, but wastes incoming to the incinerator will not); septage and sludge which is not landfilled; hazardous wastes taxed under 32 V.S.A. 237; and municipal stump dumps.

WASTE MANAGEMENT FACILITIES

Certification

Certification for a new facility will not be issued unless the facility is included in an area's plan and is consistent with the state waste management plan. Certification will specify the projected amount and type of waste as well as the facility's service area.

After July 1, 1990, an existing facility will only be recertified if it is included in the Regional Plan and is consistent with the state waste management plan, or if recertification of the facility is determined to be in the public interest by the Agency of Natural Resources.

Liners

All new sanitary landfills placed in operation after July 1, 1987 must be lined and must collect and treat leachate. (Landfills receiving less than one thousand tons of waste per year may be exempt from this requirement upon approval of the Agency of Natural Resources.)

These requirements may be waived by the Agency of Natural Resources if the facility is designed to accept only wastes which will not produce leachate harmful to human health or to the environment.

By July 1, 1991, the operating portion of every landfill must be lined. Landfills which receive 1,000 tons per year or less of municipal waste may be exempted from this requirement by the Agency of Natural Resources if no significant risk to human health or the environment is presented by the facility.

Ash from waste incinerators must be disposed of in lined facilities unless it is recycled. The recycling process must be approved by the Agency of Natural Resources.

The Transition to New Standards

New standards must be adopted by the Agency of Natural Resources by January 15, 1988. Until those regulations are adopted, no certifications or significant amendments to certifications may be issued unless a compelling public need can be shown.

Transitional operation authorizations will allow existing facilities to continue to operate under the conditions of previously issued certifications, orders, or other authorizations until new standards are issued and facility reviews are completed.

Agency review of all existing landfills must be completed by July 1, 1990. As review is completed for each landfill, the Agency will have 120 days to: 1. recertify, 2. grant interim certification to, or 3.close the facility.

Interim certifications may not be issued unless the Agency finds that: 1. there is a public need to keep the facility in operation, 2. no alternative exists, 3. interim status will afford the applicant the opportunity to complete corrective action, 4. no unreasonable threat to public health or to the environment exists, and 5. operation will not be inconsistent with state and local plans.

Financial Responsibility

Evidence that adequate funds are available to undertake all appropriate measures to protect human health and the environment must be provided by the operator of a waste management facility. The form and amount of that evidence will be set out in the new regulations.

Enforcement

Enforcement mechanisms which formerly applied only to hazardous wastes now apply to non-hazardous solid wastes as well, strengthening the state's enforcement powers.

TRANSPORTATION

Commercial haulers must now be licensed for a $10 annual fee, and the applicant must indicate the type of waste to be hauled and the area to be served. The service area will be checked against waste management facility areas through the Agency of Natural Resources, and the license will indicate, among other conditions, to which facilities the hauler has access.

APPROPRIATIONS/POSITIONS

$150,000 is appropriated to the Agency for Development and Community Affairs from the general fund for user charge implementation assistance grants. $132,000 from the Solid Waste Management Assistance Fund for administration of the act is appropriated to the Agency for Development and Community Affairs. The remainder is appropriated to the Agency of Natural Resources. $23,000 is appropriated from the transportation fund to implement the hauler licensing program. 13 new positions are created in the Agency of Natural Resources; 4 new positions are created in the Agency for Development and Community Affairs; 1 new position is created in the Department of Motor Vehicles.

INFORMATION II.C.2 SOLID WASTE PLAN SUMMARY

(The Plan is highly recommended for anyone who wishes to learn more about the reality of solid waste generation and management in Vermont. For a copy of the Plan or one of its appendices, call the Solid Waste Division, Agency of Environmental Conservation, 244-7831.)

Act 78 and the State Plan (Chapter I)

Section 6604 requires the Secretary of the Agency of Natural Resources to publish and adopt a solid waste management plan. State programs for each of the priorities of the Act are described, given available resources. Although related, State facilities for waste manangement and hazardous waste are not part of the 1989 Plan, although a hazardous waste component will be adopted by 1990. Act 78 established that Regions adopt solid waste management plans that meet the priorities of the Act and those of the State Plan. Act 78 also emphasizes waste reduction and materials reuse and recycling, and the Plan attempts to define "greatest feasible reduction in the amount of waste generated" and "reuse and recycling of waste to reduce the greatest extent feasible the volume remaining for disposal."

Defining the Nature of the Problem (Chapter II)

Current data on waste generation is analyzed, aggregated by regional planning commission boundaries. Population distribution affects waste generation; 50-75% of Vermont's mixed solid waste are from permanent and seasonal homes. Economic activity does also, including retail, office, manufacturing, and tourism industries. Water waste treatment plants and incinerators also generate waste. Several tables summarize known current (1987) waste generation. Factors affecting future waste generation are assessed. Reductions in waste generation are foreseen in the commercial and industrial sectors (where economic incentives exist), through rural home composting, and through recycling. Current on-site disposal, recycling, collection, landfill, and incinerator practices and facilities are assessed. Fact that waste recycling and disposal is inter-regional and need for new waste management facilities are noted.

Reducing Waste Generation (Chapter III)

Factors affecting waste generation are discussed. The nature of consumer products, eating out, more stringent environmental standards, and use of disposables are cited as factors increasing waste generation. Increased cost of raw materials, technologies for recycling, concern over hazardous wastes, and increased disposal costs are cited as factore decreasing generation. State responsibilities for achieving the greatest feasible reduction will include education, regulatory incentives, economic incentives and technical assistance, all of which are discussed. Regional responsibilities will include identification and monitoring of waste generators, school recycling, public education programs, and user-fee systems.

Recycling (Chapter IV)

The types of material available in the waste stream for recycling, costs associated with collecting and transporting those materials, processing required to prepare material for markets, the markets themselves, and environmental impacts are discussed. Methods to remove special wastes--batteries, tires, and household hazardous waste--are also discussed.

A goal of 40% waste reduction, composting and recycling by the year 2000 is established. State responsibilities are defined as technical assistance in assessing data on available recyclables; a possible lead role in developing multi-regional facilities; developing markets out-of- and in-state for recyclables; regulating collection and processing facilities; funding pilot programs; and developing programs for special wastes. A variety of other initiatives, depending on available resources and cooperation within State government, are also discussed. "The greatest extent feasible" is defined as requiring that Regions use a 10% cost-preference when comparing recycling options with disposal costs. Regions are to collect and analyze data on waste reduction, composting and recycling; to establish regional goals, whether greater or lesser than 40%, and have a plan with specific steps to achieve them; to avoid incineration or disposal of recyclables; and to comply with educational and environmental requirements for recycling outlined in Chapter III.

Waste Processing (Chapter V)

This chapter first reviews the relative costs, merits and problems of labor intensive, semi-mechanical, and mechanical materials recovery facilities; composting of sludge and mechanically separated waste with and without sewage sludge; incineration of of mixed and mechanically separated waste, with and without energy generation; tapping methane from buried waste; and baling or shredding of waste prior to landfilling. The State will help assess the need for inter-regional facilities, will provide technical assistance to see that technical and environmental issues are understood, will work on developing systems to handle special wastes, will work on resolving the Vicon legacy, will study the use of hospital incinerators, and will take the lead in developing markets for materials generated by such facilities. The regions must consider the long-term costs and need for any facility and establish a plan to see that any facility is operated properly and safely.

Land Disposal (Chapter VI)

Act 78 in effect requires all Regions to open new lined landfill capacity by 1991. This chapter assesses the potential for expanding existing landfills, the future demand for landfill capacity, and generally how landfills should be designed and operated. The State will carry out initial site assessments, will provide technical assistance for closure of existing landfills, will solicit contingency landfill capacity, and will develop policies for permitting, monitoring and enforcement, and leachate management of landfills. Regions must identify their specific sites to be used for land disposal in their plans and have a siting process underway if they have under seven years projected capacity.

Siting of Landfills (Chapter VII)

This chapter is an extended discussion of the need for, problems of, and process for siting a new landfill. Documented contamination, awareness of same, public skepticism of technological solutions, belief that new facilities may not be needed, competing land uses, assumption of involuntary risks, and the permitting process are all discussed as they contribute to the siting problem, and some ways of addressing these concerns are suggested. Under Act 78 Regions are responsible for siting landfills and should be able to do so provided they have a waste management plan in place and follow an unbiased siting process with strong citizen input. The siting process that must be followed is then outlined.

Summary of State and Regional Responsibilities (Chapter VIII)

The regional planning process and responsibilities of the solid waste districts are outlined, followed by a summary of State responsibilities and programs. A chart summarizes the State programs.

Appendix A Factors Affecting Waste Generation and Materials Recovery

Appendix B Solid Waste Generation in Vermont, c.1987

Appendix C Current and Future Demand for Recyclables

Appendix D Technological Options (for processing)

Appendix E Applying the Concepts of Economic Analysis (for Regional Plans)

INFORMATION II.C.3 VERMONT "BOTTLE BILL"

Americans, on average, consume 23.3 gallons of beer and 35.6 gallons of soft drink and mixes each year. In Vermont, this amounts to 200 pounds of plastic, aluminum and glass containers annually per person.

Long ago, before any beverage deposit laws existed, most soda and beer were packaged in glass bottles, and most glass bottles were designed to be returned, refilled and used again. Consumers received a deposit when they returned the bottles. When new one-way bottles and cans entered the marketplace, litter problems increased, and legislation to solve the problem was introduced.

In 1953, Vermont passed the first container law in the United States by banning the sale of beer and ale in non-returnable bottles. But when the law came up for renewal in 1957, the attempt to extend it to include steel cans brought out strong opposition from the beverage industry. The attempt to broaden the bill was defeated, and the original law was allowed to expire.

In 1972, Vermont's second container law was passed, again in an effort to reduce roadside litter. This time the law required (1) a minimum refundable deposit of five cents on all beer and soft drink containers, (2) a handling fee of 20% of the deposit (or 1 cents) to be paid upon redemption by the manufacturer or distributor to the retailer (amended in 1980 to a two cent minimum), (3) labelling on each container identifying the container as returnable in Vermont for deposit.

In 1975, the law was amended to ban detachable fliptops, "nonbiodegradable" plastic six-pack rings, and any glass bottles "not certified as refillable." Before the Bottle Law ammendments passed, only 7% of bottles were refillable and 60% were throwaway bottles. The remaining 33% were sold in bi-metal or recyclable aluminum cans. The amendments went into effect in 1977, and within a year the number of bottles "certified as refillable" increased to ninety percent. Today, the percentage of bimetal cans has dropped almost to zero, because while bimetal are cheaper to produce, they are much more difficult to recycle than aluminum.

Refillable soft drink containers can make an average of 10 to 15 round trips from consumer to bottler to consumer. However, refillables that are actually repeatedly refilled (such as bar bottles or "stubbies") comprise only about 17% of the deposit containers. Most of the bottles certified as refillable by the Agency of Natural Resources are not being refilled but are being recycled. It is estimated that 95% of all returnables are returned, and that up to 90% of them are then reused or recycled.

INFORMATION II.C.3 VERMONT "BOTTLE BILL"

BOTTLE BILL AND RECYCLING

According to Andre Rouleau of the Agency of Natural Resources, the amount of recycling in Vermont literally increased a hundred fold after first year of the Bottle Bill. At present it is estimated that under Bottle Bill programs up to ten percent of the post-consumer waste in Vermont is recycled.

In each of the other ten states with deposit legislation (Oregon, Vermont, Iowa, New York, Massachussetts, Rhode Island, Deleware, Connecticut, Maine, and California) similar success stories are told. For instance, a study conducted by the Beer Wholesalers Association indicates that within two years of its implementation the New York deposit law, implemented in 1983, had saved "$50 million on cleanup expenditures, $19 million on solid waste disposal costs, and $50 to $100 million on energy, while increasing net employment by at least 3,800 jobs." One unforeseen advantage of bottle deposit legislation is the increase in recycling of corrugated cardboard used to package the containers.

"Changing the present system for marketing beer and soft drinks can yield energy savings equal to 81,000 or more barrels of oil per day plus conserve material resources annually of 5.2 million tons

of glass, 1.5 million tons of steel and 500,000 tons of aluminum. Also, changing the system couldactually create between 80,000 and 118,000 additional jobs, save consumers as much as $1.8 billion annually and provide other desirable benefits in the form of reduced litter and solid waste."

"The purchase of a six-pack of soft drinks in returnable glass bottles instead of no-deposit, no-return containers will save the energy equivalent of 1 1/2 pints of gasoline. The saving of 1 1/2 pints of gasoline can take the average family car about 2 1/2 miles. Additionally when the empty bottles are returned for the 30-cent deposit the six-pack purchase will have cost 18 cents less than for throwaways."

SOURCES: Franchot, 1978; Andre Rouleau,. "Vermont Deposit Law and Recycling, Agency of Natural Resources, 1985; Mark Sullivan, "The ABC's About Beverage Containers," National Wildlife Federation, 1977. Pollack, 1987.

POPULATION: 535,000 (1980); AREA: 9,609 SQUARE MILES

HOW MANY LOGGING FIRMS? 650 PAPER and PAPERBOARD MILLS? 13

HOW MANY BOTTLING COMPANIES? 5

HOW MANY ESTIMATED TONS OF WASTE GENERATED IN 1986? 356,000

HOW MANY ESTIMATED TONS OF WASTE GENERATED IN 1987? 500,000

HOW MANY ESTIMATED TONS RECYCLED IN 1987? 60,000

HOW MANY PLACES TO RECYCLE? ABOUT 60 and growing

HOW MANY TRANSFER STATIONS? 41

HOW MANY LANDFILLS? 64 and decreasing

HOW MANY OF THESE ESTIMATED TO REMAIN IN 5 YEARS? 1

HOW MANY RESOURCE RECOVERY PLANTS? 2—240-ton a day plant in Rutland; a 200-ton a day plant in Claremont, NH.

HOW MANY OTHER INCINERATORS with no energy recovery?
2 large, 14 smaller

WASTEWATER TREATMENT PLANTS? 154

HOW MANY SUPERFUND SITES? 2 original —
SPRINGFIELD, WILLIAMSTOWN. 5 new added in 1988.

HOW MANY HAULERS?
Over 500 currently registered with the DMV.

HOW MANY TOWNS? 246, 57 Incorporated Villages

COUNTIES? 14

REGIONAL PLANNING COMMISSIONS? 13

SOLID WASTE DISTRICTS? 8

SUPERVISORY UNIONS? 60

SCHOOLS? 476 Public and Private

STUDENTS? 90,000+

Primitive societies produce little waste. We define objects as resource or waste depending on whether or not they are useful to us. What is waste to one person may be a resource to another. And what is an acceptable effort or risk to dispose of waste or to reclaim resources varies with peoples' economic positions and cultures.

"Waste is a human concept. In nature, nothing is wasted, for everything is part of a continuous cycle. Even the death of a creature provides nutrients that will eventually be reincorporated in the chain of life. The idea of waste springs from the perception of most material by-products of human activity as useless. But one person's waste newspapers are another person's recyclable fibers or cellulose insulation. Disposable plastic containers that are discarded without thought by the Japanese would be carefully used and reused by Tanzanian villagers. The Japanese, in turn, are aggressive purchasers of scrapped U.S. automobiles, leading to the joke that this year's Buick is next year's Datsun. And the concept of waste varies over time. Much of what were thought of as the wastes of the pulp and paper industry some decades ago are now a source of fuel and chemical feedstocks. The designation "waste" is thus a product of judgment and circumstances." (Dennis Hayes, 1978.)

"RECYCLING" IN CAIRO

"The recycling system in Cairo illustrates the different understanding of "waste" in developing countries. Wastes from the eight million households are handled mostly by two groups in Cairo: the Wayiha, who control rights to the city's domestic refuse, and the Zabaline, who rent the right to do the actual removing and processing of Cairo's domestic waste. The remove tin, glass, paper, plastic, rags and bones from the refuse, and forward these materials to factories and other markets within the city. They extract about 2,000 tons of paper a month that is reprocessed into some 1,500 tons of recycled paper and cardboard. cotton and wool rags are converted into upholstery and blankets; metals are converted into new implements; even bones are used to make such things as glue, paints, and high-grade carbon for sugar refining. Most organic wastes are fed to pigs; the rest is converted into compost that is sold for agricultural purposes. In societies with chronic unemployment, inefficient bureaucracies, and few raw materials, such labor-intensive, income-producing approaches make more sense than the capital-intensive, high-technologies favored by many Western-trained engineers." (Dennis Hayes, 1978.) [In the last ten years, a major effort has been made by Cairo officials to stop these practices for health and sanitation reasons.]

WASTE MANAGEMENT IN JAPAN

"Imagine a city where all residents routinely separate their household waste into seven categories. Virtually all newspaper, magazines, glass bottles and metal cans are sorted and recycled. After residents further remove incombustible materials and hazardous wastes, including batteries, the remaining combustible wastes and large bulky items are sent to a "Recycling Cultural Center." There, bulky wastes are screened and salvageable items, such as bicycles and furniture, are extracted and sent to a workshop where they are refurbished by handicapped persons and sold to the public.

The remaining bulky waste is shredded and metals are recovered. Some combustible waste is composted and sent to an adjacent greenhouse where it is used to grow plants for sale to the public. The greenhouse is also staffed by the handicapped, and uses steam from a waste incinerator for warmth when needed.

The incinerator is equipped with acid gas controls and is operated by trained, certified engineers. Its emissions are fully monitored. Its fly ash is cemented to prevent leaching, and mixed with bottom ash for burial in a lined landfill, along with incombustible waste. As it is filled, the landfill will be converted to accomodate recreational facilities. The cultural center also has a community swimming pool (heated by the incinerator) and classrooms where school children and community residents can learn about proper waste management..."
(New York Assemblyman Maurice D. Hinchley, 1987.)

SOLID WASTE FACTS ABOUT JAPAN

--About 50% of Japan's waste is recycled; 34% incinerated, and 16% landfilled.
--Japan has built over 1,900 incinerators in the past 25 years.
--Only .02% of the waste stream is composted and this amount is declining.
--"Japan's population density has intensified it's garbage management problems. About 60% of Japan's 120 million citizens live in areas with population densities greater than 4,000 per square kilometer and 45% of the entire Japanese population lives in the three metropolitan areas of Tokyo, Osaka and Nagoya which together comprise only 3% of the land."

% resources imported in Japan 1984

natural rubber 100.0
nickel 100.0
raw cotton 100.0
wool 100.0
crude oil 99.8
iron ore 99.7
copper ore 95.3
coal for coke making 93.5
lead ore 81.4
aluminum ore 81.2
timber 65.3
zinc ore 64.9
liquified pet. gas 58.2
wood pulp 19.2
iron and steel scrap 7.8

Source: Hershkowitz and Salerni, 1987.

NATIONAL
RECYCLING
COALITION
INC.

The National Policy on Recycling

45 Rockefeller Plaza, Room 2350
New York, New York 10111

INTRODUCTION

The National Recycling Coalition supports and recommends the implementation of policies by all levels of government — federal, state and local — by business and industry, and by individual citizens which will increase the viability of waste reduction, recycling, reuse and recovery as mechanisms for resource conservation, environmental protection and economic development.

The National Recycling Coalition recognizes the necessity of immediate implementation of public policy decisions which reduce the exploitation and disposal of limited and valuable resources and encourage waste conscious decisions. Failure to aggressively pursue change through public education, business and industry policy developments, federal, state and local rule-making authority and legislation, and individual participation will lead to the continued degradation of our environment and a weakening of this nation's competitive position in the world economy.

The secondary recycled materials which recycling industries collect, process and utilize in production have difficulty competing with virgin materials because the cost of virgin materials rarely reflects the true social and economic costs of their extraction, depletion and disposal. Individuals have come to prefer new materials even though recycled content goods often are of equal or better quality. Business and industry overlook research and development of recycled products and reutilization of materials because disposal has been easy and inexpensive.

The National Recycling Coalition calls for affirmation of the economic and social worth of waste reduction, reuse and recycling by removing all barriers to scrap, secondary and recycled materials competing favorably with virgin materials, by educating consumers to make waste conscious decisions and by involving business and industry in aggressive research and product development to increase recycling and recyclability. Recycling is a policy for a clean, safe and economically healthy future.

TRANSPORTATION POLICY

The National Recycling Coalition supports policies that make the cost of transportation, whether by rail, seagoing vessel or truck, of secondary materials originating from a recycling facility or from a manufacturer to recycling facilities, to be equal or less than the cost of transporting virgin raw materials.

TAX POLICY

The National Recycling Coalition supports and recommends that the 1986 federal tax reform measure and other tax laws be reviewed regularly to identify inequities and undue bias that provide tax advantages to the manufacture and distribution of products made from limited resources and virgin materials. In those cases where tax laws encourage the exploitation of limited resources and the continued proliferation of single-use products, those tax laws should be modified to equalize the benefits of the manufacture and marketing of products developed primarily from recycled feedstocks. The purpose is to encourage industry and consumers to reject continued exploitation and disposal of limited and valuable resources and to select products that are recycled or are recyclable.

If these benefits are not equalized the National Recycling Coalition recommends tax modifications that would address this concern including, but not limited to:

- investment tax credit
- tax incentives for new applications of waste materials, and
- purchase or secondary use tax incentives

NATIONAL LEADERSHIP FOR RESEARCH AND DEVELOPMENT AND TECHNOLOGY TRANSFER

The National Recycling Coalition endorses a national policy of the highest priority, the research, development and transfer of technology for uses in industry, commerce and all levels of government of recycled, recyclable, secondary and waste materials as the feedstock of industry. Implementation of this policy would result in less dependency on limited and virgin resources, the use of renewable, reusable and recyclable materials, and the research and development of substitute feedstocks of primarily recycled and secondary materials.

The National Recycling Coalition recommends that the Federal Government should allocate staff and resources to facilitate the transfer of information about existing and emerging recycling technologies for all commodities currently recycled from the municipal solid waste stream including, but not limited to, metal, glass, paper, plastics and yard waste. This technology information transfer should include, at a minimum:

- standardized definitions and specifications for use and applications of these materials;
- information on the value of these materials, e.g. the value of compost for agriculture productivity and landscaping.

NATIONAL RECYCLING DATA BASE

The National Recycling Coalition recommends the establishment of a national publicly accessible computerized recycling data base to provide an annual report on the national rate for recycling of all commodities recycled from the municipal solid waste stream as defined in the Resource Conservation and Recovery Act. Such a data base should initially be compiled by the federal government from the existing data bases of national trade associations, where available. Where not available, such data should be aggregated by the federal government in a confidential manner according to the Standard Industrial Classification code. In addition, the data base will include economic data on the costs of recycling commodities and of collecting and disposing of garbage. This analysis should be done with an accounting system that recognizes the avoided landfill and collection costs resulting from recycling.

STANDARD SETTING ORGANIZATIONS

The National Recycling Coalition urges that all public and private bodies with responsibility for fixing product standards consider the ease of recycling at the end of the product's useful life and the use of waste materials in the manufacture of new products as factors in standard development.

A NATIONAL POLICY FOR ENVIRONMENTAL QUALITY

The National Recycling Coalition supports and recommends a national policy of the highest priority that achieves maximum environmental quality, the use of renewable energy sources, alternative fuels and maximum materials recycling.

The National Recycling Coalition further supports and endorses the following:

Product Design for Recyclability

The National Recycling Coalition supports and recommends that manufacturers consider reuse and recycling in product design. The National Recycling Coalition supports and encourages business and industry policies and government action to eliminate, to the maximum extent possible, factors in the design of products which impede the products' recyclability and inject hazards into the recycling process.

Maximum Enforcement of Procurement Laws

The National Recycling Coalition recommends the maximum enforcement of existing laws requiring the procurement by governmental agencies of materials and supplies made from recycled materials. The National Recycling Coalition recommends the immediate establishment and enforcement of recycled product procurement requirements at all levels of government.

PUBLIC-PRIVATE PARTNERSHIP

The National Recycling Coalition recommends that municipal, county and state governments accord priority consideration to pre-existing private sector, volunteer and nonprofit programs in the development and implementation of solid waste management and recycling plans. Pre-existing programs providing satisfactory service should be incorporated into those plans.

A NATIONAL POLICY FOR RECYCLING EDUCATION

The National Recycling Coalition recognizes that education is the key to affecting change that results in rational decisions to increase waste reduction and utilize recycling. Through a national education policy that emphasizes environmental quality, resource conservation, waste reduction, recycling and sustainable growth, society in the future can enjoy the best of science and technology and live in harmony with nature.

Additionally, the National Recycling Coalition recommends the following educational components as part of a strong recycling educational policy:

Buy Recycled Program

The National Recycling Coalition strongly encourages a program to encourage consumers to purchase durable, reusable and recyclable goods. The program would emphasize the environmental advantages of recyclable consumer goods.

Labeling

The National Recycling Coalition supports the labeling of consumer items to identify only those products which can be practically recycled by the consumer and shall encourage a Buy Recycled Program.

Curriculum Development

The National Recycling Coalition believes that educational systems should develop and incorporate recycling curriculum and education as a major component in the school curriculum. The National Recycling Coalition believes it is extremely important that students learn to make rational waste-conscious decisions and to recycle at the waste generation level.

Recycle Week

The National Recycling Coalition supports the national enactment of an annual "Recycle Week" as a means to remind and educate the population about the benefits of recycling.

Postage Stamp

The National Recycling Coalition encourages the U.S. Postal System to develop a recycling commemorative postage stamp set to demonstrate the national commitment to recycling and remind the public that recycling helps communities care for the environment.

Commercial Sector Education

The National Recycling Coalition supports a national policy that encourages business and industry to establish and promote educational programs that inform consumers about the recyclability of consumer products and the potential hazards resulting from the disposal of the products which they manufacture and sell.

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From Home

egg cartons, cardboard tubes, plastic containers (margarine tubs, bleach bottles, squeeze bottles, etc.) juice cans (small frozen type and large ready-made type), meat and produce trays, strawberry boxes and baskets, bottle caps, corks, aluminum pie tins, styrofoam packing material, coat hanger, magazines, sturdy boxes, corrugated paper and cardboard, buttons, spools, ribbon, yarn, string, rope, old clothes (dresses, socks, constumes), old stockings, hats, jewelry, eyeglasses, trinkets, fabric anb fabric scraps, old greeting cards, old magazines, wrapping paper, broken appliances with moving parts (e.g. clocks, radios, fans, etc.), electronic equipment scraps, plumbing pipe, popsicle sticks, old toothbrushes, rug and carpet pieces, L'eggs containers, wood scraps and pieces, any useable paper, poster, or cardboard, candles and wax, rubberbands, nails and screws, paper bags and plastic bags, maps, durable containers, foam rubber, used envelopes and manilla folders,... large appliance boxes or crates, boards, bricks and concrete blocks, old furniture (especially desks, lamps, and shelves), wallpaper leftovers and wallpaper books, rugs, pillows and cushions, fabric and felt, wire screen and chicken wire, baskets, rulers, yardsticks and tape measures, leftover paint, sewing patterns, books (especially childrens' books), records, musical instruments, tiles and linoleum squares, straws, games and puzzles, clay, natural and found objects (e.g. flat stones, pine cones, feathers, driftwood, rice, beans, etc.) carbon paper, ditto stencils and paper, kitchen utensils, any paper products, (crepe paper, used or new paper cups and plates, tissue paper, contact paper, etc.), paste and glue, tape, staplers, staples and paper clips, scissors and paper cutters, crayons, pencils and pens, tools (hammers, saws, screwdrivers, etc.), sewing machines, record players, typewriters, orange crates, toys (old or new),.....

From Businesses

Airlines - plastic cups, packing boxes

Art Supply Stores and Stationery Stores - leftover or damaged paper; any leftover or damaged stock (e.g., paint, pencils, paper clips, staplers, staples, markers, etc.)

Architects - blueprints and blueprint paper; slide rules and other tools

Building Supply Companies - wood and lumber, tiles, wallpaper books, color samples, leftover formica

Bottling Firms - bottle caps, large cardboard tubes

Churches - old candles

Container Companies - large cardboard sheets, damaged containers - sturdy and of uniform size

Contractors - lumber, pipes and wire, wallpaper, linoleum, tiles, molding wood, wood curls, etc.

Department Stores - stocking boxes, lingerie boxes, fabric swatches, rug pieces, corrugated packing cardboard, packing boxes from appliances and pianos, styrofoam packing material, decorative displays, old posters and business forms (blank on one side), shoe boxes, envelopes, etc.

Dime Stores - boxes, leftover or damaged packs of crayons, leftover toys, school supplies, etc.

Drug Stores - small plastic bottles, crayons and other school supplies

Electric Power Companies - wire, large spools, assorted packing materials

Furniture Stores and Factories - large packing boxes, packing material, fabric scraps and swatches, scrap lumber

Garment Factories, clothing firms - buttons, decorative tape, ribbon, yarn trim, spools, fasteners, fabric scraps, etc.

Gift Shops and Boutiques - candles, packing boxes, styrofoam packing material, wrapping paper, ribbon, etc.

Grocery Stores, Food Coops, Outdoor Markets - cartons, packing materials, fruit crates, large cardboards and materials from displays, discarded display racks, styrofoam fruit trays, baskets of any sort

Hardware Stores - sample hardware books, sample tile charts, linoleum samples, rope, chain, wood, molding strips, etc.

Ice Cream Stores - 3 gallon ice cream containers

Interior Designers - fabric, carpet and flooring samples and scraps

Leather Craft Companies - scrap pieces of leather and lacings

Lumber Companies - scrap wood, damaged bricks, concrete blocks, doweling, wood curls, etc.

Offices Of Any Sort - discontinued business forms and posters (anything blank on one side), pencils and erasers, office furniture, file cabinets, lamps, typewriters, envelopes, manila folders, large brown envelopes, etc.

Paint Stores - any leftover paint, samples, sample books, wallpaper books, end rolls of wallpaper, tiles, linoleum, etc.

Paper and Printing Companies - endcuts and damaged paper and posters

Phone Companies - colored wires, old telephones, large spools

Photographers and Framing Shops - empty film containers, scraps from matboard and foam core

Plastics Companies - trimmings, cuttings, tubing, scrap plastic and plexiglass

Plumbers and Plumbing Supply Companies - wires, pipes, tile scraps, linoleum

Printmakers and Artists - paper and matboard scraps

Quiltmakers and Rugmakers - scraps of fabric and batting

Repair Shops - unclaimed appliances (preferably working, but nonworking also) - TV's, clocks, fans, lamps, record players, typewriters, sewing machines, radios, etc.

Restaurants - old candles, mushroom baskets and other empty food and produce containers, corks, ice cream containers, bottle caps, boxes and cartons

Rug Companies - any leftovers or scraps, sample swatches, end pieces from carpets

Textile Companies - color samples, any scraps or pieces

Tile and Ceramic Companies - leftover or damaged tile, etc.

Toy Stores - leftovers, damaged products, packing materials, boxes

Upholsterers and Tailors - buttons, scrap material, spools, cord, string, etc.

INFORMATION III.B.1 THE WORLD OF RECYCLING

First things first!

If we don't make it, we won't have to get rid of it. The United States produces far more trash than any other nation in the world. First we need to reduce the waste we produce. In the United States about 200 million tons each year. In Vermont about half a million tons each year. Too much is designed to be thrown away soon after purchase. Disposables have been taking over the marketplace and our lives. After careful thinking, what we decide we do need, we should try to reuse as many times as we can before recycling it. We should try to throw out as little as possible.

Preconsumer Recycling

Recycling of materials goes on consistently within industries. What can be saved within the manufacturing process saves money and generates more profit. Small savings repeated over and over do add up to a substantial savings for the producer. Most scrap metal, plastic, paper, and glass are all recycled in the production of consumer goods.

Recycling on this level is easy because the waste is CLEAN. It has not been contaminated with old banana skins and rotten tomatoes. It is also in one place. Which means it does not have to be collected back from all corners of the earth and the end of every dirt road.

Postconsumer Recycling

Once we've reduced our usage and reused things just as much as we can, we will still produce some waste. But bottles can be designed to be reused by industry and then recycled. Many resources that we throw away are potentially valuable and could be reused. Washing a glass bottle and using it again saves all the energy it took to make the bottle, although it also consumes some energy to pump, heat, and later treat the water used.

Recycling, since it involves the making of new products, will contribute its own share to our waste and pollution problems. Recycled paper making requires use of energy and water and produces much pulp-sludge.

De-inking of paper for recycling concentrates potentially toxic ink substances in its waste. Aluminum recycling requires much less energy but produces a similar amount of air pollution potential when it is smelted. However, overall recycling saves energy and natural resources, reduces pollution, and saves valuable space in landfills.

How much can we really recycle?

The EPA has estimated that 26% of urban trash can be recycled. A 1986 trash composition studies at a landfill in Vermont revealed that about 31% of the residential waste stream was food and yard wastes that could have been composted, and up to another 29%, if source separated, had the potential to be recycled.

The question for some time has been whether it is really feasible to recover these resources. Several myths about recycling have stood in the way. "People won't separate their trash." "Recycling cannot make a serious dent in the waste stream." "Recycling costs too much." However, as the cost of waste disposal increases, more and more people are recycling at least some their waste, and this is beginning to make a difference in the amounts of waste requiring disposal.

Beverage Container Deposit Legislation

Bottle bills increase recycling by providing a substantial financial incentive and by providing convenient redemption centers. They make it easier and provide an incentive for consumers to separate recyclable deposit containers from their trash. Because of deposit legislation, an estimated 90% of returnable containers are recycled in Vermont.

Economic Incentives

Market conditions for recyclable materials are dependent on demand. For example, much of our paper is exported and other paper is used by the building trades. When exports or construction are strong, prices for paper are good. Other materials depend on the demand for that particular material. While running a paper or aluminum drive may be a good fundraiser, basing an ongoing waste management recycling program on estimated profits can be disastrous. To improve the market conditions for recyclables, we need to remove regulatory and policy barriers to the use of recycled materials and increase the specifications for and number of products made with secondary (recycled) materials.

Avoiding the skyrocketing costs of trash disposal now provides a real financial incentive to recycle. Because of the demand for landfill space and the rising costs of disposal, over $100 per ton in some U.S. communities, recycling has become a desirable and economically feasible waste management technique.

Recycling is also more successful when user fees are imposed for disposal according to how much trash a person, business or community produces. When recycling costs less than disposing of their recyclables as trash, people have an economic incentive to recycle. Residences who pay a flat weekly rate regardless of how many bags of trash they produce have no financial incentive to reduce their waste. Whether they put out one bag each week or six, they will pay the same amount. People who pay a tipping fee per bag of trash at the local landfill have that incentive; materials separated for recycling are not charged the disposal fee providing an economic incentive to keep waste to a minimum. There is a need to develop an incentive for haulers so that they will charge a similar rate based on how much trash they collect instead of charging a flat fee.

Waste disposal costs for communities work the same way. If a landfill has a contract with a municipality to accept all its trash over a certain time period, regardless of the amount to be delivered, the waste hauler has an incentive to provide pickup service to more people and no incentive to reduce the amount of trash he delivers. If, however, he is charged per ton or cubic yard delivered to the landfill the incentive for cost-avoidance through waste reduction, recycling and composting exists.

Source Separation

Separating glass, paper, metals and other recyclables before they get mixed in with the trash is called source separation. Once set aside, these materials can be taken to a recycling center or picked up by a waste hauler at curbside.

Source separation requires individual participation and is much less expensive than having the materials separated at a facility after being mixed together. Source separated materials are also often cleaner, command a higher price, and may therefore help offset more disposal costs. Mandatory source separation ordinances have been enacted in some communities and have proven to be a successful tool for increasing participation in recycling programs.

Although many home-dwellers who have not tried it think source separating is difficult, those who regularly practice it find that it is easy and takes up little more space than unsorted waste. Generally many people in a community are anxious for the opportunity to recycle. When the City of Seattle began its voluntary curbside recycling effort, it expected that it might get 25% of the households to sign up for the program; almost 60% of eligible households responded in the first month.

INFORMATION III.B.1 THE WORLD OF RECYCLING

Recycling Programs

There are many different ways to run a recycling program. Communities must decide which is the best for them according to variables such as geography, population, markets, regional and state government plans and current waste stream composition. Recycling programs can be as simple as running a newspaper drive or as complicated as setting up a full service recycling center or curbside collection program. The following collection systems are common.

DRIVES are one shot collections usually organized for one material. They are popular as fundraising events for schools and community organizations, but can only make a temporary dent in the waste stream.

RECYCLING DROP-OFFS are the most common in Vermont presently. Bins, sheds or boxes are set up at accessible public locations for the supervised or unsupervised drop-off of materials. Drop-off locations require a special trip by the recycler unless they are located in a place where most people already need to go, such as at a school, a grocery store parking lot, or a landfill or transfer station.

BUY BACK CENTERS are recycling centers where materials are brought and and exchanged for payment. Some centers will pay individuals for small amounts of recyclables; others provide payment only for large amounts.

REVERSE VENDING MACHINES are mini-automated buy-back centers. They are a recent addition to the recyclable collection system in the U.S. Where beverage containers have deposits, they provide automated collection of aluminum, glass and plastic soft drink bottles similar to soda vending machines. Containers are inserted, and money is dispensed automatically to the customer.

In CURBSIDE RECYCLING PROGRAMS each household separates and prepares its recyclables from the trash according to guidelines provided by the business or agency providing the recycling service. Haulers can pick the separated materials up with the regular trash or pick up the recyclables separately.

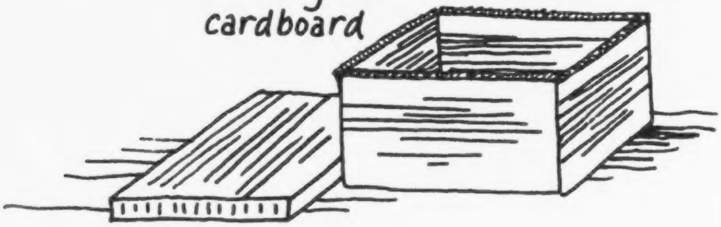
At the recycling center

At recycling centers, materials are sorted, processed and made ready for shipping to manufacturers. Aluminum and tin-plated steel cans are crushed and baled. Glass is separated by color, crushed into very small pieces called cullet and contaminants such as bottle caps and rings are removed. Newspapers, corrugated cardboard and other grades of paper are also baled for shipping. Plastic is either punctured and baled or shredded. Some ten to twenty percent of incoming collected materials is not recycled due to contamination and processing litter and becomes waste that is shipped to the landfill. Like all waste management facilities, recycling centers do generate truck traffic and noise and must control litter and dust.

Materials Recovery Facilities (MRFs)

Once materials enter the waste stream, it is much more difficult and expensive to retrieve them for recycling. What has been all jumbled up together must be taken back apart. Machines have been designed to separate recyclables back out of the trash. Machines can shred the waste and pass it through tunnels which use air to separate out paper and other light materials. Magnets are used to separate iron and steel. Heavy substances such as glass are separated out by weight. Hi-tech separation facilities are very expensive, and prone to mechanical failure. "Low-tech, High-touch" facilities, where people sort through mixed recyclables by hand, pulling out paper, ferrous materials, aluminum, plastic, glass and other recyclables, are messy, but they work and do provide low-skilled jobs for people. However, such jobs are noisy and dangerous because of the machinery and can expose workers to many of the health risks associated with solid waste.

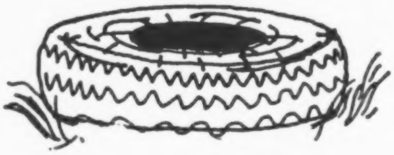
SEE INFORMATION SECTION I.B.5.a-e. and I.B.6.b-c. for information on how paper, glass, metals, tires, plastic, waste oil, and batteries are recycled.



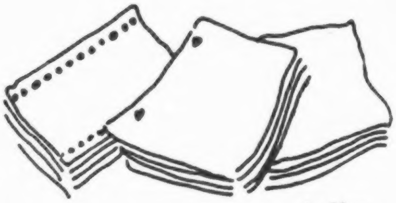
corrugated cardboard

scrap metal and old appliances

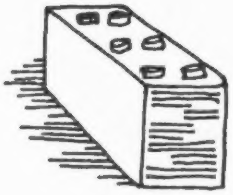
plastic milk or cider jugs



tires



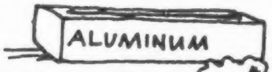
white ledger paper



car batteries

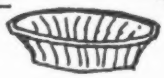
News print

glass bottles and jars



aluminum cans

used foil



aluminum pie plates

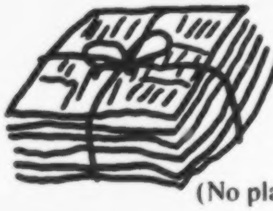
Even used motor oil

textiles

INFORMATION III.B.3 HOW TO SEPARATE RECYCLABLES

(Contact your local recycler or market for exact specifications.)

NEWSPAPER



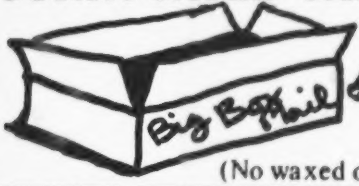
Bundle and tie or lay flat in a large, paper, grocery bag.

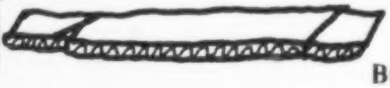
YOUR GROCERY INC.

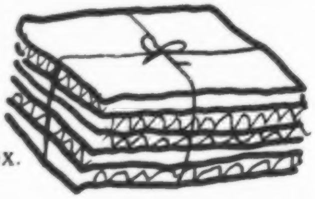
(No plastic twine or bags.)

CORRUGATED CARDBOARD

Break and flatten corrugated. (Look for ribbed, wavy layer.)



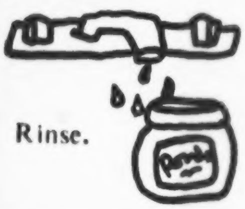




Bundle and tie or box.

(No waxed or plastic-coated cardboard.)

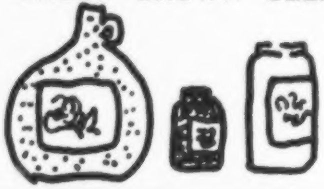
GLASS



Rinse.

Separate by color.

GREEN - BROWN - CLEAR



Remove metal or plastic caps and rings.

NO lightbulbs

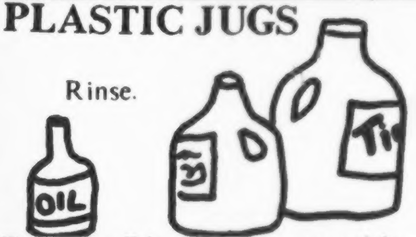
NO windows

NO ceramics, pyrex, or tableware

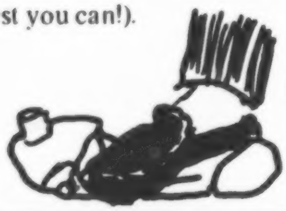
Bag or Box.

PLASTIC JUGS

Rinse.



Crush (as best you can!).

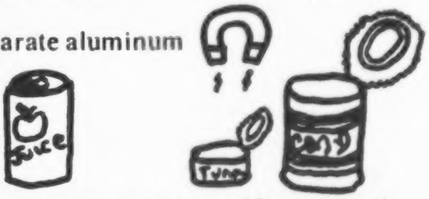


Bag or Box.

(For motor oil jugs, leave caps on and do not rinse.)

METAL

Separate aluminum from steel.

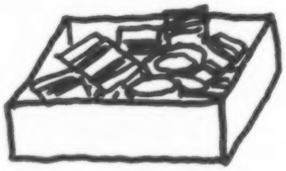


Rinse completely. Remove any labels.

Remove ends of cans.

Flatten.

Bag or Box.



(Aluminum is not attracted by a magnet)

PAPER

Separate white ledger from mixed, colored paper.

No paper clips.

No envelopes.

Bag or Box.

CBS

RECYCLING FACTS

- According to a 1986 Vermont landfill composition study, approximately 31% of residential trash is composed of food and yard wastes which could be composted, while up to another 29%, if source separated, could have been recycled.
- According to one estimate, making paper from recycled fibers at the factory requires 61 percent less water, 60-70 percent less energy, and produces 70 percent fewer pollutants.
- Producing an aluminum can from bauxite ore requires twenty times as much energy as making it from recycled aluminum.
- If you buy beer or a soft drink in an aluminum can, chances are better than fifty-fifty that your can was made from other cans; the time between its leaving the factory and dropping into the melting furnace once more may be only three months. ("The Fascinating World of Trash," National Geographic)
- Of the 356,000 tons of garbage produced in Vermont in 1986, only 60,000 tons (about one-sixth) were recycled.

  —50,000 tons of the 60,000 resulted from the Bottle Bill.

  —At least an additional 60,000 tons of waste could and should be recycled through other recycling projects.
- In the year following the passage of Act 78, at least fifteen new community recycling programs started in the State of Vermont.
- Recycling half the paper used throughout the world today would free 20 million acres of forestland from paper production. (WWP56)
- Throwing away two aluminum cans in a day wastes more energy than is used used daily by each of one billion people in poorer countries. (Oregon DEQ)
- According to the Environmental Protection Agency, recycling all municipal paper and metal would prevent release of 2000 tons of air pollutants and 700 tons of water pollutants annually in the US. (Wastewise)
- The .0015 inch coating of tin on a "tin can" represents one-third of the recycled value of the can while comprising only .25 to .4 percent by weight.
- One gallon of used motor oil can be rerefined into two and one half quarts of lubricating oil . . . The United States could reduce petroleum imports by 25.5 million barrels of oil each year and save 1.3 million barrels of oil each day by rerefining its used motor oil. (Oregon DEQ)

Adapted from *A Way With Waste* a programof the Washington State Department of Ecology.

WHY START A RECYCLING PROGRAM IN YOUR SCHOOL?

Benefits to Students

A carefully designed recycling program gives students the chance to put into action the values and attitudes promoted in solid waste and recycling activities. It meets needs of students to be involved in practical, hands-on, economically rewarding school projects. Participating in a school recycling program shows students how their classroom skills can be usefully and profitably applied to the solving of real problems. Participation introduces secondary school students to the procedures of managing a business as well as making them aware of skills needed for possible future careers. And by running a school recycling program, students will have the chance to do something that is beneficial not only to the school but to the entire community as well.

Benefits to teachers and school

Because of the high percentage of paper waste a school creates, a paper recycling program can drastically reduce the amount of solid waste a school produces and in turn cut disposal costs.

A recycling program may also generate funds for school programs.
A recycling program promotes cooperation between teachers, students and administration, and encourages teachers to include topics with immediate practical application in their curriculum.

A well-run school recycling program can improve relations between the community and the school district with the school providing a service to the community, serving as a community center, and demonstrating a commitment to protecting the environment and keeping education expenditures at a minimum.

Benefits to community

The community benefits from a school recycling program through reduced school disposal costs and prolonged life for landfills. If open to the community, residents will have a nearby, reliable recipient for recyclables, and parents are given a way to get involved in their children's school life.

WHAT KIND OF RECYCLING PROGRAM IS RIGHT FOR YOU?

There are several options available to schools for starting recycling programs.

1) Establish an account at the local recycling center, if there is one. Any payments for materials brought in by parents and community members can, in this way, be credited to fund school projects.

2) Conduct occasional recycling drives. Recyclables can be stored at home until the time of the drive.

3) Have students assist community groups already active in recycling.

4) Set up bins and drop boxes for the recyclables generated by the school. This can be as easy as putting used cardboard boxes for ledger and mixed paper in each classroom. Regularly deliver or arrange for pickup of these materials by a local recycling group or recycling business.

5) Set up a long-term recycling center at the school which can serve as a community center, combining recycling, composting and gardening, and other community services and events in a year round program.

INITIAL INVESTIGATION

Various considerations need to be taken into account when determining which recycling option is right for your school. Some first steps in helping you decide are outlined below:

1) Determine if there is a nearby recycling facility which could support your program. Contact recycling businesses to see what services and payment may be provided or what fees must be paid to recycle different materials. (e.g. bins, materials accepted, hauling of recyclables, current prices paid, etc.)

2) Determine what types of materials you wish to recycle, what their specifications are for marketing, and what the prevailing market conditions for the materials are. (e.g. Do advertising inserts have to be removed from newspaper? Do tape and paper clips have to be removed from ledger paper?)

3) Investigate other organizations in the community that regularly recycle to see if you might work in cooperation.

4) Conduct a Survey. Have students develop and distribute in the school, and if applicable to parents and to the community, a survey that would determine:

a. How many students would be interested in participating in a recycling program.
b. How much material the school would be willing and able to handle.

c. How materials would be collected at the school and transported to the recycler.

d. If parents and community members keep recyclable materials separated and stored at home. If not, would they be willing to do so?

e. If parents and community members would be willing to bring recyclable material to the school or school-maintained recycling bins.

5) Contact your Regional Solid Waste Planner and Solid Waste District Manager to discuss your information gathering and ideas about program design.

A LONG-TERM RECYCLING PROGRAM

Evaluate the results of your initial investigation to determine the degree of recycling activity appropriate for your school. If your school decides to set up a school recycling program or establish a full-line donation recycling center for the community, then the following step-by-step procedures should be used.

STEP 1 CONSIDER THE COMMITMENT

Carefully consider the extensive commitments in time and equipment needed for the success of a long-term recycling program. Remember that the goal of any school recycling is not only to increase recycling and reduce waste, but to strengthen recycling in your region. Make sure you continue to work closely with your Regional Solid Waste planner and Solid Waste District Manager.

STEP 2 CONDUCT A FEASIBILITY STUDY

1. School project leaders contact student groups potentially responsible for program initiation and operation. Consideration should be given to developing a structure for ongoing, year-to-year management of the recycling program.

2. Evaluate the initial recycling survey to determine the scope of the project.

3. Write a letter to be distributed at school and to be sent home or to businesses explaining the benefits of the school recycling program and requesting support of the program.

4. Estimate possible costs: cost of renting storage space, facility construction costs, supplies and equipment, insurance, maintenance costs, utilities, wages, disposal and pick-up fees.

5. Investigate possible funding sources: school recycling drives for start-up cash, PTA, local service clubs, local businesses, student body general fund, student stock options, regional solid waste district.

6. Evaluate possible site locations in terms of: obtaining permission from landowner, accessibility, visibility, nuisance factors (noise, smell), ordinances (health, fire, zoning), characteristics of materials to be recycled.

7. Evaluate surveys, project scope, economics, and location/storage considerations to decide which materials will be recycled. Do not forget to check your markets again, and get an assessment of the long-term stability or instability of your markets.

8. Present results of feasibility study to school staff (faculty, secretaries, custodians, cooks), Superintendent and School Board for approval and support. Outline the benefits for students, school, and community.

STEP 3 PLAN AND DEVELOP THE RECYCLING FACILITY

1. Determine if the center will be a staffed center or an unstaffed drop-off point. Consider location, project scope, and worker availability.

2. Design a school or community recycling facility, taking into account site location, materials being recycled, space needed for covered and uncovered storage, level of participation, and potential for expansion. Consult recyclers on design specifics (e.g. vandal-proofing, ramps for moving barrels, access/egress, etc.)

3. Develop management structure to cover the following responsibilities:
    - A. Supervisor - faculty director coordinates overall program.
    - B. Supervisor and students:
        1. evaluate all project components and reporting procedures
        2. describe and promote the project to those interested
        3. enforce fire, health, and safety regulations
        4. decide how funds, including profits, are disbursed
        5. handle contract negotiations and arrange pickups
    - C. Student responsibilities:
        1. scheduling worker hours and pickup schedule
        2. keeping records of material flow
        3. accounting
        4. stacking and storing recyclables
        5. maintaining good public relations -- handling complaints, publicity and promotion
        6. maintaining and cleaning up the site

4. Outline student pay and benefits for working in the center. For example:
    - A. Students may earn a wage for their hours worked.
    - B. Students may earn credit for a club, etc.
    - C. Students may earn class credit for work in the center.
    - D. Students may earn credit for school or community service.

5. Obtain adequate insurance covering student workers and transportation of materials and liability insurance covering the center's operation. (Check school insurance covering students.)

6. Scheduling:
    - A. Establish practical hours for the center to be open. It is highly recommended that if the school's recycling program is a community program materials pickup continue in the summer to ensure service to contributors.
    - B. Establish a schedule for transportation of collected materials to the recycler. Base this schedule on the flow of materials and size of the center's storage space.

7. Facility regulations and operating instructions:
    - A. Post fire, health, and safety regulations so anyone using the bins or working in the center will be aware of them.
    - B. Post clear instructions telling people how to prepare recyclables. (i.e. glass separated, newspaper stacked and tied, etc.)
    - C. Post opening and closing procedures for workers.
    - D. Post additional signs with a telephone number for complaints and more information, so school officials and secretaries will not be bothered unnecessarily.

8. Plan a publicity and public education campaign to inform the school population, and if applicable the community, and to encourage participation.

[** One possibility for structuring student participation in a project is to pattern it after New Hampshire's CANS FOR EDUCATION program which simulates a corporate structure including election of a board of directors, employment and stockholder policies. (see curricula)]

9. To learn more about recycling programs at other schools and what has and has not worked for them, contact the Association of Vermont Recyclers, P.O. Box 1244, Montpelier, VT, 05602 for contact names and phone numbers.

WHAT'S RECYCLABLE IN SCHOOLS?

Here are some basic guidelines for recycling common materials. However, it is important to ***always, always*** check individual specifications with your recycler.

Classroom paper can generally be separated into two categories for recycling:

LEDGER PAPER: clean, white paper including computer paper, stationery, copy paper, lined notebook paper, and typing paper.

Note: White paper is still recyclable even if it has magic marker or paint on it.

MIXED PAPER: most other non-white papers incuding construction paper, manilla paper, folders, and newspaper.

Remove Contaminants: rubber bands and paper clips (these are reusable!), carbon paper and carbonless paper, post-it notes, envelopes, staples, tape, non-water soluble glues, etc.

Store paper flat to save space.

BOOKS: Outdated textbooks and library books, as well as paperbacks and hardcovers from home, are collected by some recyclers. Covers and bindings are stripped off to be recycled into wallboard or building paper. Depending on the quality of the paper, inside pages are recycled with ledger or mixed paper.

CORRUGATED CARDBOARD: Cardboard often constitutes much of a school's waste stream and can easily be recycled by separating from trash and storing in a dry place. Cardboard should be flattened and excess plastic and tape removed.

STEEL CANS: Much commercial food is packaged in steel cans. (Steel is attracted by magnets, while aluminum is not). Steel cans should be rinsed thoroughly, the ends detached and the cans flattened to save space.

PLASTIC CONTAINERS: Plastic containers for food and cleaning products may be recyclable. Plastic containers should have their caps and rings removed, be rinsed thoroughly and be crushed as flat as possible. It is important to determine what kind of plastics are being used and to verify that they are indeed recyclable before beginning to collect and save them.

ALUMINUM CANS: Aluminum cans, whether deposit non-deposit containers, are easy to collect and easily recyclable. Bins can be set up next to vending machines or in other high-traffic areas for collection. Money collected from return of deposit containers can be used to fund student projects.

ORGANIC WASTES: Certain cafeteria wastes are compostable. Guidelines for establishing a school composting project are available from the State of Vermont, (800) 932-7100. Also available are guidelines for other cafeteria waste reduction strategies including the use of reusable tableware vs. disposables.

See also: 9-12 O III.B.2 COLLECTING AND SORTING, 7-8 O III.B.1 SOURCE SEPARATING, and RESOURCES B.7 SOURCES OF RECYCLING CONTAINERS.

OVERVIEW

In nature, everthing is recycled. Nature first pulls nutrients out of the earth for plants to nourish themselves with. And then, when plants and animals die, they return to earth, to nourish the soil and be used once again by new growing things. But humans, in developed countries at least, have two ways of interrupting this cycle or damaging it, and create sewage and landfill problems.

Sewage

Although water disposal of organic waste has many health and cost benefits, it also has notable drawbacks. Water, which we consider a renewable natural resource, is becoming less and less pure and hence less usable, in part because of sewage. Pumped out of septic systems and municipal sewage plants, 25 billion gallons of sludge is produced daily in the United States. Of this 15% goes into ocean, 35% is burned, 25% buried. The remaining 25% is salvaged in composting processes and is spread on land as a soil conditioner.

There are problems with composting sewage sludge, however. Bodily waste together with household chemicals and detergents is flushed into septic or municipal systems, thereby mixing biodegradable and potentially hazardous elements. Industries also contribute chemical waste to sewage being processed, contaminating it with hazardous substances, such as solvents, and heavy metals, such as cadmium and mercury. Any resulting soil conditioner may therefore also be contaminated. This potential contamination increases the costs of using it as a soil conditioner (since it must be tested for contamination), limits where it can be applied, and may lead to public opposition to its application.

Composting toilets hold out some promise for allowing water-less disposal of bodily and kitchen wastes in homes. Contraptions like the Clivus Mulstrom are large fiberglass containers into which kitchen garbage and human wastes are dumped. The wastes work their way slowly down to the bottom of the container while air circulates through them, and the bacteria slowly decompose and transform the waste into soil conditioner over a one to two year period. The volume of waste can be reduced by 90%. However, these devices are not in many respects fully perfected (particularly in their ability to remove water from the wastes).

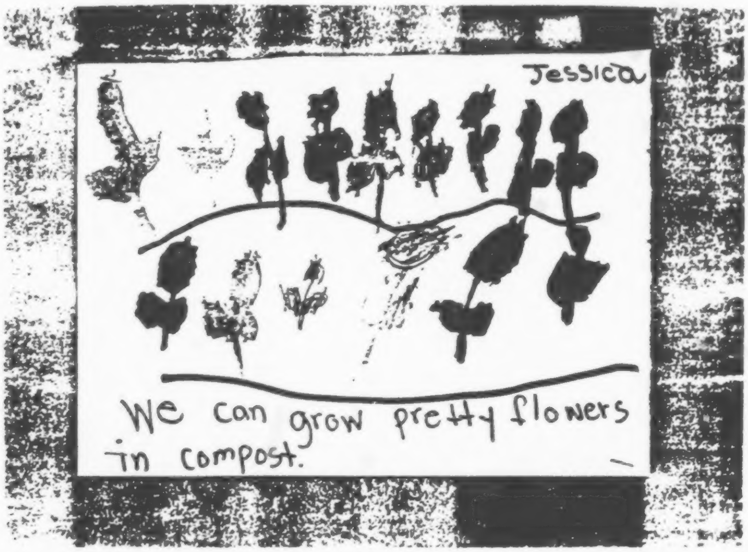
Solid Waste

According to Agency of Natural Resources estimates, somewhere between 25 and 50 percent of Vermont's solid waste is biodegradable and may be easily compostable. Included in this estimate are food and yard wastes and, to a limited extent if shredded, some paper and other wood products.

There are two ways to break down this solid waste. In landfills, when waste is buried with no oxygen supply, anaerobic decomposition occurs. This form of break down works very, very slowly so that waste buried for a decade may evidence little or no decomposition. It also results in the production of methane and other gases, which can cause safety problems or be tapped as an energy source.

In designed composting systems, decomposition of organic solid waste occurs aerobically. This means that there is constant interaction between microbes, air and water. Such composting requires attention to make sure the several conditions necessary are maintained. These include air, moisture, sufficient mass, a balanced mix of ingredients, and timed redistribution of the material. The point of composting is to keep those little creatures breathing happily while they are working hard to break down food and yard wastes into nutritious humus. In properly designed and operated composting systems, the bad odors caused by rotting microorganisms can be eliminated, though great care is needed to properly operate these facilities.

Although advances in composting systems may make possible the biodegrading of much solid waste, the resulting compost must also be disposed of or dispersed in the environment. Because of the rural character of Vermont, the potential for dispersing compost on forested and other lands is better than in more developed states, but the costs of transporting and spreading the compost are a limiting factor. If coated papers and other wood products, with inks and trace amounts of metals, are included in a compost mix, the resulting compost, because of potential contamination, may face many of the same dispersal problems as treated sewage sludge.


Jessica
We can grow pretty flowers in compost.

LEAF COMPOSTING

Each fall, we are confronted with tons of leaves falling from trees on our lawns. While Vermont's rural character reduces the need for disposal of leaves and other yard waste, its suburban and urban areas are increasing. Adding leaves to landfills wastes rich organic matter and adds to standard leachate, methane, and space problems.

Last fall, Gardener's Supply initiated Vermont's first leaf composting program in Burlington. In conjunction with the city's Public Works Department, Gardener's Supply collected leaves from homeowners, issuing coupons for two free bags of compost fertilizer for each load of leaves delivered to the project.

The biggest challenge to the project was coordinating collection and transportion of the estimated 1,500 cubic yards of leaves. Burlingtonians were given a choice of drop-off locations around the city to deposit their bags of leaves. This resulted in excess labor and trucking costs, as well as the need to dispose of plastic bags used to contain the leaves. In the future, citizens will bring their leaves to one central location where the composting actually occurs. Leaves may also be collected curbside by a vacuum truck or in compostable paper bags.

Many other Public Work Departments located in Vermont urban areas already collect and dispose of their leaves each fall, usually to keep drains clear and as a service to residents. Most of these leaves are not composted and end up being landfilled; a small percentage are usually given to some who use them for various purposes, including composting.

In New Jersey, where open land is more scarce and landfill space at a premium, leaves have been designated as one of the mandatory recyclables in the State Solid Waste Plan. Leaf composting has become widespread, with at least 160 municipal leaf composting facilities throughout the state. In Vermont, the new State Solid Waste Management Plan requires that in time large quantities of leaves be banned from landfills and encourages that they be composted instead.

In Burlington, leaves were composted with manure to create a rich fertilizer that could be sold, but this added extra steps and costs to the composting process. Other communities in Vermont may design their leaf composting programs with other goals in mind, using technologies appropriate to achieving their goals. The different methods of municipal leaf composting (that do not add manure) can be separated into three levels:

1. Minimal technology, which is not designed for rapid composting and involves separating leaves into windrows and turning leaves with a front-end loader once each year. A site using this method should be isolated, due to anaerobic conditions resulting in unpleasant odors. Advantages include the small amount of space needed and the low time, labor, and energy commitments.

   (The extreme winter weather of Vermont creates some problems for "minimal technology" composting. In Burlington, the leaves and pig manure all froze and the process had to be halted until the spring thaw. For a composting operation accepting waste year-round outside, this would be a problem.)

2. Low-level technology, a more rapid method of composting which uses more space and costs more than the first method; leaves are spread out into more piles and are monitored for moisture content, oxygenation, and temperature within the piles. Although this method is more intensive, it is less likely to generate unpleasant odors.

3. High-level technology is used when space constraints and the need to complete the composting process in one year is the main priority. This method

costs substantially more, requires investment in structures, and involves more monitoring of the process, frequent turnings using more sophisticated machinery, and the addition of moisture.

Much like home composting, municipal leaf composting on a "minimal technology" level does not have to meet all biological requirements exactly. However, as the level of technology increases, so does the cost and complexity of the project. Due to necessary economies of scale, organizaers of municipal leaf composting must understand both the basic processes and have the necessary resources, including space, labor, machinery, other technology, and a steady source of leaves to ensure the project success.

Sources: Personal communication with Paul Zabriskie, June 1987; Wastwise; Up In Smoke, February 1988.

[Thanks to Michael Bender of Central Vermont Regional Planning Commission for drafting this material.]

GARDENER'S SUPPLY
PRODUCT BULLETIN

Simple Steps to Successful Composting

Building and maintaining a compost pile is the surest, easiest way to become a better gardener. You'll not only be producing the best possible food for your garden, but when you watch a pile of leaves, eggshells, orange rinds and grass clippings become rich, black humus filled with earthworms and other soil creatures, you learn about the key to successful gardening–**healthy soil**. Healthy soil produces healthy plants. And a healthy plant has more resistance to stress, pests and disease, produces higher quality, more nutritious fruit and has lush foliage and flowers.

Most gardeners don't start with good soil, and even if they do, they don't expect that soil to remain productive without replenishing it with organic matter and other plant nutrients. Composting is the most efficient way to feed your soil. Some of the advantages are:

- ✓ You recycle valuable materials that might otherwise be discarded as garbage.
- ✓ Finished compost is uniform in texture and odorless. Well-screened compost can be used in a fertilizer spreader, side-dressed, or used in potting mixtures.
- ✓ Composting concentrates organic matter so you won't have as much material to spread.
- ✓ Nutrients are stabilized against leaching and are slowly available to crops during the entire growing season.
- ✓ You can add mineral fertilizers and micro nutrients to compost to ensure a more balanced distribution of nutrients.
- ✓ The heat generated during composting destroys most weed seeds, perennial roots and pathogens.
- ✓ Beneficial microorganisms and soil fauna multiply in the composting environment. Substances which enhance plant health, such as antibiotics, are produced.

The Basics of Composting

Microorganisms and soil fauna break down organic matter. To accelerate the composting process, you need to provide the best possible environment for these beneficial organisms to do their work. When a gardener puts materials together that match the requirements of these decay organisms, the process works very rapidly–in as short a time as two weeks.

Food

Decay organisms require a combination of carbohydrates and protein. A carbon to nitrogen ratio of 30 to 1 is the perfect balance to speed the composting process.
Carbohydrates (carbon) usually dry, tough, fiberous plant material incuding fall leaves, straw, sawdust, shredded paper, corn stalks.
Protein (nitrogen) green vegetation and animal by-products including grass clippings, kelp meal, kitchen garbage (non-meat), manure and urine, blood meal, freshly cut weeds.

Any kind of organic material is good for the compost pile, but try to add it in the proper proportions. Make sure materials are not too coarse; shred bulky items for quicker decomposition.

Adding micronutrients, seaweeds, rock powders, or other materials may not feed the decay organisms but will produce a richer compost. You may also add a compost inoculant like our Bio-Activator (powdered beneficial microorganisms) to encourage rapid breakdown of the organic matter. Layering the materials will help distribute them evenly through the pile and will also help you gauge the proportions of the carbon to nitrogen. You may wish to add some topsoil to the nitrogen layer. This will introduce beneficial soil organisms and bacteria.

Moisture

In dry weather or when incorporating dry materials like fall leaves, you may need to water the compost pile. If the pile is usually uncovered, you may want to put a plastic tarp over it to retain moisture while the pile is heating up. The compost pile should be consistently damp, but not wet. (The material should feel like a well-wrung sponge not too dry but not soggy.) Decay organisms function best in an aerobic (air-filled) environment. Too much moisture will force out air and suffocate beneficial organisms. In rainy weather a tarp will also keep excessive moisture out of the pile.

Closed units like our Soil Saver and the Green Magic Tumbler usually maintain an ideal moisture level, but they should be checked once in a while for moisture content.

Air

The aerobic digestion process requires alot of oxygen. A fast-acting pile will run low on air in about three days. Turning or mixing the compost not only aerates the material but also encourages temperatures to rise quickly to hastening the decomposition process. If speed is not important, the pile will need little manipulation, but turning it even once will cut decomposition time in half. The more you turn, the quicker the compost will be finished and the sooner you can begin another batch.

Heat

If you have provided the correct carbon to nitrogen ratio, the pile should heat up to about 110° F within 24 hours after it is put together. At this point, the pile should be turned with our Compost Aerator or a pitchfork. There will be few visible changes in the material, but after turning, the temperature will rise further.

In a few days, the pile should be turned or aerated again. At this point the material will be evenly moist and grey fungus growth should be evident. The temperature should continue to rise. Turn the pile a third time after a few more days have passed. Material in the pile should now be even-textured and after turning, the temperature should reach 150-160° F. At this temperature the organic material will be pasturized, killing most weed seeds and pathogens. If the pile does not get hot enough, you will need to add more nitrogen, such as blood meal or manure. If there is a strong ammonia smell, there's insufficient oxygen. Turning the pile will incorporate more air, but the pile may also be just too wet. You may need to add more carbohydrates like wood chips or sawdust to absorb excess moisture.

Once the temperature has reached the 150° F range, it will drop to approximately 110° F. Decomposition will continue at this lower temperature more slowly. Eventually the temperature will stabilize and the compost will be ready for the garden. The carbon to nitrogen ratio will be approximately 10 to 1, about the same as naturally occurring humus. Once the compost is ready, it may be spread over the entire garden, used as a side dressing or placed in planting holes.

Compost Size and Containers

A pile 3' x 3' x 3' is the minimum size for good composting action. The organic material needs to be piled on top of itself to generate and retain heat. The location of the compost pile, its size and the amount of material you're adding will determine the type of compost bin you use. There are many different designs, but all have the same objectives: to retain heat and moisture, to provide good bottom drainage, to make aeration easy and to keep animals out.

The most important message we have to give you is not to be flustered by complicated instructions and advice about composting. Just begin, do what you can and watch closely. Compost-making is a simple, natural process because decay is an inevitable law of nature. Even if you do nothing at all, a pile of organic matter will eventually decompose. By composting, you are just improving upon and speeding up this natural process. Whatever you do, nature is with you- you can't go wrong!

Gardener's Supply Co.

128 Intervale Road, Burlington, VT 05401
802-863-1700

advertising making known or praising publicly, usually in order to sell something.

aerobic decomposition decomposition of organic wastes occurring in the aresence of oxygen, making possible conversion of material to compost.

alumina an oxide of aluminum, Al2O3, obtained from bauxite and used to make aluminum.

aluminum a light silvery-white metal made from bauxite ore that can be easily bent or crushed.

anaerobic decomposition decomposition of organic wastes occurring in the absence of oxygen, by bacteria which breathe an inorganic oxidant. Causes production and release of methane gas.

baghouse a fabric filter used in incinerators to remove air particulates from smoke stack emissions.

baling a volume reduction technique where a baler compacts mixed solid waste or recyclables into cubes or bricks, usually using wire or steel straps to hold it in place.

bauxite the principle source of aluminum, containing alumina and impurities.

bill a proposed law offered to a legislative body.

biodegradable capable of being broken down naturally by microorganisms into simple, stable compounds such as carbon dioxide and water. Most organic wastes are biodegradable.

bottom ash residue from burning which collects at the bottom of the incineration chamber.

BTU British thermal unit, a unit of heat required to raise the temperature of one pound of water one degree Farenheit at or near 39.2 degrees F.

cellulose inert substance constituting the chief part of the cell walls of plants; also the major component of paper.

classify to arrange or sort materials into uniform categories

collection picking up waste materials or recyclables from homes, businesses or industrial sites, and hauling them to a facility for further processing, transferral or disposal.

combustibles various materials in the waste stream which are burnable.

commercial waste waste material which originates in wholesale, retail or service establishments, such as office buildings, stores, markets, theatres, hotels and warehouses.

compactor any power-driven mechanical equipment designed to compress and thereby reduce the volume of waste materials.

compactor truck a common refuse collection vehicle with an enclosed body having special power-driven equipment for loading and compressing trash.

composting the natural conversion of most organic materials to humus by microorganism activity, and an effective solid waste management technique for reducing the organic portion of waste.

conservation the planned management of a natural resource to prevent exploitation, loss, destruction, or neglect, or waste.

construction waste waste materials produced in the construction of homes, office buildings, dams, industrial plants, schools, etc. (usually includes used lumber, sheetrock, miscellaneous metal parts, packaging materials, cans, boxes, wire, excess sheet metal, etc.)

consumer a person who buys goods or services for his own needs and not for resale or for production of other goods for resale: as opposed to producer.

container a thing in which material is held or carried; recepticle. something that holds something else -- a box, a trash can, an eggshell, a bottle, a garbage truck.

contamination process by which something is made impure.

convenience being suited or favorable to one's comfort, purpose, or needs; increases comfort or makes work less difficult.

conversion the process of changing solid waste, through chemical or physical process, into some other material like energy or soil. Composting and burning waste are both conversion processes.

cover material a backfill, usually earth, free of organic material, used to cover compacted waste in a sanitary landfill.

crusher mechanical device used to compress waste materials or recyclables into smaller sized pieces.

cullet scrap glass broken up into small (dime-size), uniform pieces.

cycle circle, return, occur again

decompose to break down, come apart, change form, to break down into basic elements; to rot.

decomposition the breakdown of organic waste materials by bacteria, either by aerobic or anaerobic process, into carbon dioxide, water and inorganic solids

de-inking a process in which most of the ink, filler and other extraneous material is removed from reclaimed paper, prior to the recycling of the fiber into new paper.

deposit money paid by consumer to retailer (in the purchase price) for returnable beverage containers, and refunded to consumer when container is returned to store.

dewatering a process of removing water by filtration, centrifugation, pressing, open-air drying or other methods, to prepare sewage sludge (or paper pulp) for disposal by burning or landfilling.

dispose to get rid of, to remove. to get rid of waste; properly, by putting it into a proper container for collection and final processing by burying, burning or recovery of its resources.

disposal the final disposition of wastes usually by burying it on land.

disposable designed to be thrown away after use.

dump n. an open and unmanaged disposal site used prior to sanitary landfills where waste materials were burned, left to decompose, rust, or simply remain. v. to throw away garbage or solid waste in a place set apart for that purpose.

dumpster large refuse container to keep waste until it is collected by a trash hauler, usually used by stores, restaurants, apartment buildings, etc.

ecology the scientific study of the relations of living things to one another and to their environment. From Greek "oikos" -house (home) - knowledge of our "home' - the earth, air and water.

ecosystem a system made up of a community of living things and the physical and chemical environment with which they interact.

energy the work that a physical system is capable of doing in changing from its actual state to a specified reference state; power, which may be in several forms - steam, electrical atomic, chemical, human, etc.

energy recovery technologies which produce energy from solid wastes including 1) capturing the heat energy produced by burning mixed solid wastes and converting it to electricity, 2) producing an industrial fuel from mixed solid wastes, and 3) extracting methane from landfills for conversion and use as natural gas.

energy resources resources used as sources of power and/or heat generation including renewable resources (wood, hydro, biomass, etc.) and nonrenewable resources (coal, petroleum, natural gas, uranium, etc.)

environment all the conditions, circumstances, and influences surrounding and affecting the development or existence of people or of nature. one's surroundings, inside or out-of-doors.

ferrous pertaining to or containing iron.

ferrous metals metals composed mainly of iron, and generally magnetic.

fly ash the ash collected during the burning of solid wastes in an incinerator by the pollution control devices.

fossil fuel naturally-occurring nonrenewable hydrocarbon such as coal, crude oil, or natural gas formed over extremely long periods of time from fossil remains or organic materials, and consumed to produce energy.

garbage wastes originally referring to food and wastes from food preparation (from kitchens, restaurants, grocery stores, slaughter houses or food processing plants), but now generally includes all waste considered worthless and thrown away. Another word for solid waste, especially household waste.

garbage can large covered container used to store household waste until it is collected.

glasphalt a highway paving material in which recovered ground glass replaces some of the gravel in asphalt.

glass a chemically inert, impermeable, transparent, non-porous, odorless material produced primarily from silica, soda ash, limestone, and feldspar.

Gross National Product (GNP) the total market value of all the goods and services produced by a nation during a specified period.

groundwater water within the earth that supplies wells and springs.

habit an action a person does repeatedly and routinely without thinking about it.

hazardous waste waste materials produced by industries which are dangerous to living things or the environment because they have one or more of the following characteristics: (a) poisonous, (b) explosive, (c) corrosive, (d) readily burnable with or without a flame, (e) carriers of diseases, or (f) radioactive.

household hazardous waste waste materials commonly used in small quantities in the home which have some or all of the characteristics of hazardous waste and should not be disposed of in the same manner as solid waste.

human-made anything made by people or machines (clothes, books, cakes, milk cartons, desks, etc.)

hydrogen an active gaseous element which has the simplest atom of any element: one proton and one electron, hydrogen is the most plentiful element in the universe.

hygiene the science of health and the prevention of disease.

illegal dumping the illegal disposal of solid waste in any place not authorized to accept waste material; usually done to avoid tipping fees at landfills.

incinerate to burn waste and thereby reduce the amount of waste requiring landfilling.

incinerator a plant designed to reduce waste volume by burning.

inorganic designating or composed of matter that is not animal or vegetable; not having the organized structure of living things; most inorganic compounds do not contain carbon and are derived from mineral sources.

landfill a large outdoor site for the burial of solid waste.

leachate a liquid that has percolated through solid waste and/or been generated by solid waste decomposition and has extracted, dissolved, or suspended materials in it; a liquid containing decomposed waste, bacteria and other poisonous materials which drains from landfills and must be collected and treated to prevent it from contaminating ground and surface water supplies.

ledger paper office grade white paper including stationery, copy, and computer paper.

lime mineral or industrial form of calcium oxide; a base; used in the production of glass, in pollution control devices in incinerators, and to control acidity in composting.

litter waste materials which are carelessly discarded in an inappropriate place or which accidently escape waste-handling systems.

littering improperly and illegally disposing of waste by allowing it to escape appropriate waste-handling systems.

manufacture to make products, especially on a large scale and with machines.

materials recovery manual and/or mechanical separation of recyclables or compostables from mixed solid waste.

methane a colorless, odorless, flammable gaseous hydrocarbon (Ch4) present in natural gas and formed by the decomposition of vegetable matter; usable a fuel.

mixed paper waste paper of various kinds and quality, including manilla folders and colored copier paper, construction paper, newspaper, etc.

natural anything in our world not made by people or machines (e.g. eggs, rocks, trees, turtles, flowers, water, etc.)

natural resources naturally-occurring items such as plants, animals, people, minerals, water, and air which are used by people to help make things used by people (food, energy, clothes, buildings, etc.)

newsprint an inexpensive paper made from wood pulp or recycled paper, used primarily for newspapers.

nitrogen cycle the continuous cyclic progression of chemical reactions in which atmospheric nitrogen is compounded, dissolved in rain, deposited in the soil, assimilated and metabolized by bacteria and plants, and returned to the atmosphere by organic decomposition.

nonferrous metals metals which contain no iron, such as aluminum, copper and brass.

nonrenewable resources natural materials which, because of their scarcity, the great length of time required to form them and their rapid depletion, are considered finite, including natural gas, oil, and minerals.

ocean dumping the dumping of raw or treated wastes in the sea beyond the continental shelf.

open burning the illegal burning of waste materials in the open or in a dump (sometimes accidental, sometimes intentional to reduce volume), which can produce smoke, odor, and other toxic pollutants.

organic a. derived from living organisms. b. pertaining to any chemical compound containing carbon.

organic refuse a. waste material made from substances composed of chemical compounds of carbon in combination with other chemical elements, primarily hydrogen, and generally manufactured in the life processes of plants and animals. including paper, food waste, plastic, and yard wastes. b. once living material, or products of a living thing (egg shells, dead flowers, coffee grounds, etc.)

packaging the wrappings, container or sealing used to protect, identify and advertise a product.

particulates very small particles of matter.

photodegradable capable of being broken down by ultra-violet light.

planned obsolescence a marketing concept developed to increase production and sales by creating products which must be replaced frequently (either because they have gone out of style or are designed to break easily or be disposable).

plastic any one of many human-made materials consisting wholly or in part of a combination of carbon with hydrogen, oxygen, nitrogen, and other organic and inorganic elements which are produced by polymerization, and which can be molded, extruded, or cast into various shapes and films or drawn into filaments and used as textile fibers.

pollution harmful substances deposited in the air, water or on land, leading to a state of dirtiness, impurity, or unhealthfulness.

polymerization linking together small, single chemical units called monomers in repetition to build one large molecule called a polymer.

pulp a cellulose fiber and water combination used to make paper. can be made from virgin wood, recycled paper, or other cellulose-based plants.

pyrolosis the process of chemically decomposing an organic substance by heating it in an oxygen-deficient atmosphere. high heat is usually applied to the material in a closed chamber evaporating all moisture and breaking down materials into various hydrocarbon gases and carbon-like residue. The residue may be further processed into useful materials, such as carbon, sand and grit, or can be landfilled.

reclamation the restoration to usefulness or productivity of materials found in the waste stream.

recycle a. to put or pass through a cycle again; b. to collect and reprocess manufactured materials for reuse either in the same form or as part of a different product.

recycling center a site where manufactured materials are collected and resold for reprocessing.

redesign to change one's habits and actions; to improve an object or policy's quality or usefulness by incorporating a new design element.

reduce to lessen in extent, amount, number, or other quantity.

refillable an energy-saving glass beverage container designed not only to be returned for deposit but washed and refilled with beverage for resale.

refuse a general term for solid waste materials.

refuse-derived-fuel fuel that is made from waste materials

renewable resource a naturally occurring raw material or form of energy derived from an endless or cyclical source, such as the sun, wind, falling water (hydroelectric), biofuels, plants and animals.

resources a supply of something that can be used or drawn upon. something that can be used to make something else -- wood into paper, iron ore into steel, bauxite ore into aluminum, sand into glass, old cans into new ones, old bottles into new ones, old newspapers into cardboard.

resource recovery a. burning of mixed solid waste to produce energy; b. processing of mixed solid waste to make refuse-derived fuel; c. the extraction and utilization of materials or energy from the waste stream; d.production of compost using solid waste as a medium; e. taking usable materials out of solid waste, usually through high-technology processes.

returnable a beverage container able to be returned to a vendor, usually with a deposit payable to the consumer upon return.

reuse to extend the life of an item by repairing or modifying it, or by creating new uses for it.

revise to change our attitudes and improve our knowledge of solid waste in order to realize both the scope of the problem and our responsibility for its solution through careful buying and responsible waste disposal. change buying habits to include reduction of solid waste through recycling, reuse, and reduced consumption.

sand worn or broken rocks, larger than dust and smaller than gravel.

sanitary landfill a specially located and engineered site for the land disposal of solid waste, designed to minimize public health and safety threats and to prevent litter, rodents, open burning, pollution of ground and surface water, etc. Wastes are compacted and covered daily with several inches of soil.

scrap waste with some value, especially materials left over from construction or manufacturing suitable for reprocessing.

sewage liquid and solid wastes carried off with water in sewers and drains.

sludge any heavy waste deposit, sediment, or mass that precipitates in a sewage system tank.

soda ash crude sodium carbonate; used in the manufacture of glass.

solid waste a. all solid and semisolid wastes, including garbage, rubbish, ashes, industrial wastes, swill, demolition and construction wastes, and household discards such as appliances, furniture, and equipment. b. all useless, unused, unwanted or discarded material (refuse, trash, garbage, debris, etc.)

solid waste management the controlling, handling, processing and disposal of all refuse; everything that has to be done to get rid of all the waste that is produced in the community.

source separation the sorting out of recyclable materials at home and in school; sorting recyclable materials into specific types, such as paper, corrugated cardboard, aluminum, and glass, by the person who last uses the materials at the place they are generated.

steel a tough and widely used metal composed of a mixture of iron, carbon, and sometimes other metals.

thermoplastic plastics composed of long polymer molecules which are not joined chemically, and so may be softened by heat and formed into any shape.

thermoset plastics plastics composed of polymer molecules which have been chemically linked to other polymer molecules, and which cannot be remelted into new forms.

tipping fee disposal fee paid to a landfill or incinerator

transfer station a place where solid waste is taken in smaller vehicles, sometimes processed or compacted, and reloaded into large trucks for more cost-efficient transportation to landfills, recycling dealers and resource recovery sites.

trash another word for solid waste.

virgin material any basic material for industrial processes which has not previously been used; e.g. wood pulp trees, iron ore, silica, crude oil, bauxite, etc.

waste n. anything that cannot be used anymore or that has no value v. to treat a resource as waste

waste basket small container, usually used indoors, for disposing of small waste items.

waste processing doing something to discarded materials so they can be handled more easily, or so resources can be recovered from them.

waste stream all the waste material output of an area, location or facility. All materials being thrown away, including resources.

waste-to-energy plants facilities which employ burning techniques to produce salable energy from solid waste.

windrow a form of compost pile, usually five to six feet high, and as long as needed.

METRIC CONVERSION CHART*

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.08	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2,000 pounds)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

METRIC CONVERSION CHART*

LENGTH

symbol	unit	number of meters
km	kilometer	1,000
hm	hectometer	100
dkm	decameter	10
m	meter	1
dm	decimeter	0.1
cm	centimeter	0.01
mm	millimeter	0.001

AREA

symbol	unit	number of square meters
km^2	square kilometer	1,000,000
ha	hectare	10,000
a	are	100
ca	centare	1
cm^2	square centimeter	0.0001

MASS (weight)

symbol	unit	number of grams
t	metric ton or tonne	1,000,000
kg	kilogram	1,000
hg	hectogram	100
dkg	decagram	10
g	gram	1
dg	decigram	0.1
cg	centigram	0.01
mg	milligram	0.001

VOLUME

symbol	unit	number of cubic meters
cm^3 (or cc)	cubic centimeters	0.000001

CAPACITY

symbol	unit	number of liters
kl	kiloliters	1,000
hl	hectoliter	100
dkl	decaliter	10
l	liter	1
dl	deciliter	0.1
cl	centiliter	0.01
ml	milliliter	0.001

TEMPERATURE
Celsius scale

°C	degree Celsius
O°C	freezing point of water
100°C	boiling point of water

*This chart is reprinted with permission from the **Project Learning Tree Supplementary Activity Guide for Grades K—6** (Washington, D.C.: American Forest Institute, 1977).*

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AGENCY OF DEVELOPMENT AND COMMUNITY AFFAIRS
Office of Economic Development
Recycling Markets Department
109 State Street
Montpelier, VT 05602
(802) 828-3221

Major Functions:

-Provides support for the development of recycling industries in Vermont.
-Provides support for the development of new industries in the state which will use recycled materials.
-Provides solid waste planning grants to regional planning commissions and solid waste districts for the development of comprehensive waste management plans;
-Administers implementation grants and loans for waste management projects;
-Assists municipalities in developing a system of user fees for municipally-operated solid waste facilities.

AGENCY OF HUMAN SERVICES
Department of Health
60 Main Street
P.O. Box 70
Burlington, VT 05402
(802) 863-7200

Environmental Health Division
(863-7220)

Major Functions:

-Investigates food or waterborne disease outbreaks and food or drinking water contamination incidents;
-Provides consultation to health officers and the public on private water supply and sewage disposal problems;
-Provides technical aid to public water systems;
-Provides technical aid to schools, towns and individuals on asbestos removal.

Laboratory Division
(863-7335)

Major Functions:

-Provides bacteriological, immunological, environmental, and toxicological sample analysis (drinking water quality tests, tests for asbestos in building materials, etc.);
-Provides data interpretation, consultation, and expert testimony on all test methods and results.

Occupational and Radiological Health Division
(828-2886)

Major Functions:

-Regulates and inspects work places and other sites for safety and health hazards exposure;
-Provides training, information, and recommendations about hazardous and toxic materials;
-Provides information about hazardous chemicals in the work place (Community Right-to-Know Law).

Research, Statistics, and Data Processing Division
(863-7300)

Major Functions:

-Provides analysis of population, birth rate, death rate, and migration patterns;
-Holds vital records from 1955 to present.

Publications:

-*Fact sheets on Drinking Water*;
-*Hazardous Chemical Registry* (hazardous chemicals used in the work place in Vermont);
-*Water Testing Guide* (information about water testing and costs);
-*Annual Vital Statistics Report*.

AGENCY OF NATURAL RESOURCES
Department of Environmental Conservation
103 South Main Street
Waterbury, VT 05676
(802) 244-6916

Air Pollution Control Division
Building 3 South
(244-8731)

Major Functions:

-Issues permits for sources of air pollution in Vermont;
-Inspects and tests existing sources of air pollution;
-Conducts planning for the control and abatement of air pollution;
-Implements the state's air quality plan;
-Conducts acid deposition research and planning;
-Monitors air quality throughout the state.

Publications:

Self-contained Slide/Tape presentations:
-*Choices: Risk Assessment, Risk Management*;
-*Trackdown--Waste Oil*;
-*A Cause For Alarm--Acid Precipitation*;
-*Air Pollution Control Regulations*.

Permits, Compliance and Protection Division
West Office Building
(244-5674)

Major Functions:

-Reviews proposed sewage disposal and water supply facilities for permitting;
-Issues permits for discharges (industrial, pretreatment for discharges to municipal sewer systems, municipal discharges, stormwater discharges, etc.) to state waters;

-Investigates complaints concerning water pollution, rubbish and garbage, and potential violations of Act 250 laws;
-Operates with eight field investigators and five regional offices.

Public Facilities Division
9 South
(244-8744)

Major Functions:
-Administers a program of permits approving sludge disposal sites for municipal sewage treatment and water treatment plant sludges, septage disposal sites, and industrial sludge disposal sites.

Hazardous Materials Management Division
West Office Building
(244-8702)

Major Functions:
-Manages the state's hazardous waste program including issuance of permits and certifications for transport, storage, treatment and disposal of hazardous waste;
-Inspects hazardous waste facilities;
-Oversees the manifest system that tracks hazardous waste from point of generation to point of disposal;
-Enforces against improper hazardous waste manifest practices;
-Manages the state's environmental release management program including permitting existing and new underground storage tanks and licensing tank inspectors;
-Manages cleanup of uncontrolled hazardous waste sites;
-Responds to emergencies involving spills of petroleum products and other hazardous wastes.

Solid Waste Management Division
West Office Building
(244-7831)

Recycling Hotline:
(800) 932-7100

Major Functions:
-Manages the permitting and inspection of solid waste storage, treatment, and disposal facilities;
-Enforces against improper disposal practices;
-Implements the State Solid Waste Management Plan;
-Provides technical assistance to municipalities, regional planning commissions, and solid waste districts in planning and implementing regional solid waste plans.

Recycling Section
-Maintains a library of solid waste and recycling periodicals including: Waste Age, Resource Recycling, Beverage World and BioCycle;
-Coordinates meetings of the governor-appointed Technical Advisory Committee covering solid and hazardous waste issues;
-Provides public information on recycling and recycling programs;
-Manages the state's returnable beverage container program;
-Coordinates statewide special waste programs such as scrap metal and used oil;
-Provides assistance to individuals and businesses interested in starting recycling or waste reduction businesses.

Publications:
-*Act 78: Vermont's Solid Waste Law*;
-*A Guide to Vermont's 1987 Solid Waste Law*, Dec. 1987;
-*Solid Waste Implementation Task Force Report* and Appendices, Nov. 1987;
-*Directory of Recycling Collection Programs*, July 1989;
-*Directory of Recycling Equipment*, Nov. 1988;
-*Directory of Markets for Recyclable Materials*, July 1989;
-*State of Vermont Solid Waste Plan and Appendices*, Jan. 1989;
-*State of Vermont Solid Waste Rules*, Jan. 1989;
-How, Why and What to Recycle Booklet, 1989;
-Diapers: Its your Choice (brochure), Jan. 1990;
-Brochure on State assistance for recycling businesses, 1989;
-*The Wasting of Vermont* (video, 27 min.), Feb. 1989.

Water Quality Division
Building 10 North
(244-5638)

Groundwater Management:
-Maps, classifies, and manages the state's groundwater;
-Operates groundwater level and quality monitoring networks;
-Prepares reports on groundwater levels and quality for the public;
-Provides technical assistance on groundwater quality, quantity, and wells.

Monitoring and Surveillance:
-Issues permits for the introduction of chemicals to state waters;
-Prepares biological/chemical studies of discharges in state waters;
-Manages the lay monitoring program where citizens are trained to take samples analyzed by the department and used to monitor the quality of Vermont waters;
-Prepares biological/chemical studies of the impacts of discharges in state waters;
-Develops and implements state toxic control strategy;

Water Resources Planning:
-Reviews and provides input on Act 250 applications and discharge permits;
-Conducts water quality studies;
-Reviews proposed municipal wastewater treatment facility designs;

Engineering and Hydrology:
-Conducts assimilative capacity studies and develops wasteload allocation models for Vermont waters.

Wetlands:
-Coordinates the state's wetland management program;
-Assists the Water Resources Board in the designation of wetlands;
-Assists in the identification and management of wetlands;
-Provides public information on wetlands;
-Provides assistance to Act 250 commissions.

Publications (a complete list is available):
-*Wasteload Allocation Studies/* Wetland Publications
-Ground Water Reports: *An Ounce of Prevention*, Ground Water Favorability Maps, Aquifer Protection Areas.

AGENCY OF NATURAL RESOURCES
Department of Fish and Wildlife
103 South Main Street
Waterbury, VT 05676
(802) 244-7331

Major Functions:
-Implements species management plans;
-Conducts research on wildlife habitat and species population;
-Enforces wildlife protection laws and hunting regulations;
-Provides educational services for general public.

AGENCY OF NATURAL RESOURCES
Department of Forests, Parks and Recreation
103 South Main Street
Waterbury, VT 05676
(802) 244-8715

Major Functions:
-Manages state's forests, parks and natural areas.
-Provides educational, technical and financial assistance in the areas of forestry, recreation, and conservation education.
-Conducts classroom workshops on papermaking and conservation of forest resources.

AGENCY OF NATURAL RESOURCES
Office of the State Geologist
103 South Main Street
Waterbury, Vt 05676
(802) 244-4164

Major Functions:
-Provides basic and specific information to the Agency, other branches of the state, federal, or local government, private industry or the public;
-Provides technical review and input to the Interagency Act 250 Review Committee on applications for mining or extraction of earth resources.

Publications:
Publications of the Vermont Geological Survey (one copy of each publication free to schools; list of titles and prices available). Generalized Map of Vermont ($.15/copy for schools). Speakers on Vermont Geology (available to area schools on limited basis).

DEPARTMENT OF AGRICULTURE
116 State Street
Montpelier, VT 05602
(802) 828-2100

Major Functions:
-Instructs and tests all applicators of pesticides, issues permits for use of pesticides and investigates complaints of improper use;
-Tests samples of innumerable compounds for the presence of chemicals which could be harmful;
-Provides continuous sampling of all milk and milk products produced in the state.

DEPARTMENT OF PUBLIC SAFETY
Emergency Management Division
103 South Main Street
Waterbury, VT 05676
(802) 244-8721

Major Functions:
-Maintains plans to protect people and property of Vermont in the event of nuclear warfare, hazardous materials accidents, radiological accidents at fixed nuclear generating facilities, and natural disasters;
-Conducts damage surveys during and immediately after natural or technological disasters;
-Maintains and updates a library of federal, state and private sector publications on emergency management of hazardous materials;
-Operates a 24-hour hazardous materials hotline (1-800-641-5005) and Duty Officer System.

DEPARTMENT OF PUBLIC SERVICE

129 State Street
Montpelier, VT 05602
(802) 828-2321
(800) 642-3281

Major Functions:
-Represents the public before the Public Service Board in utility cases.
-Schools and Hospitals Program channels federal grant dollars to schools, hospitals and public institutions for energy conservation measures such as energy audits, engineering studies, and retrofits.

Publications:
Several energy conservation pamphlets available.

ENVIRONMENTAL BOARD

58 East State Street
Montpelier, VT 05602
(802) 828-3309

Major Functions:
-Administers Act 250. Applications filed with one of the nine District Environmental Coordinators for land use permits are reviewed by a District Environmental Commission, each consisting of three citizen members appointed by the Governor.

Publications:
Act 250: Vermont's Land Use and Development Law Title 10, Chapter 151; Environmental Board Rules.

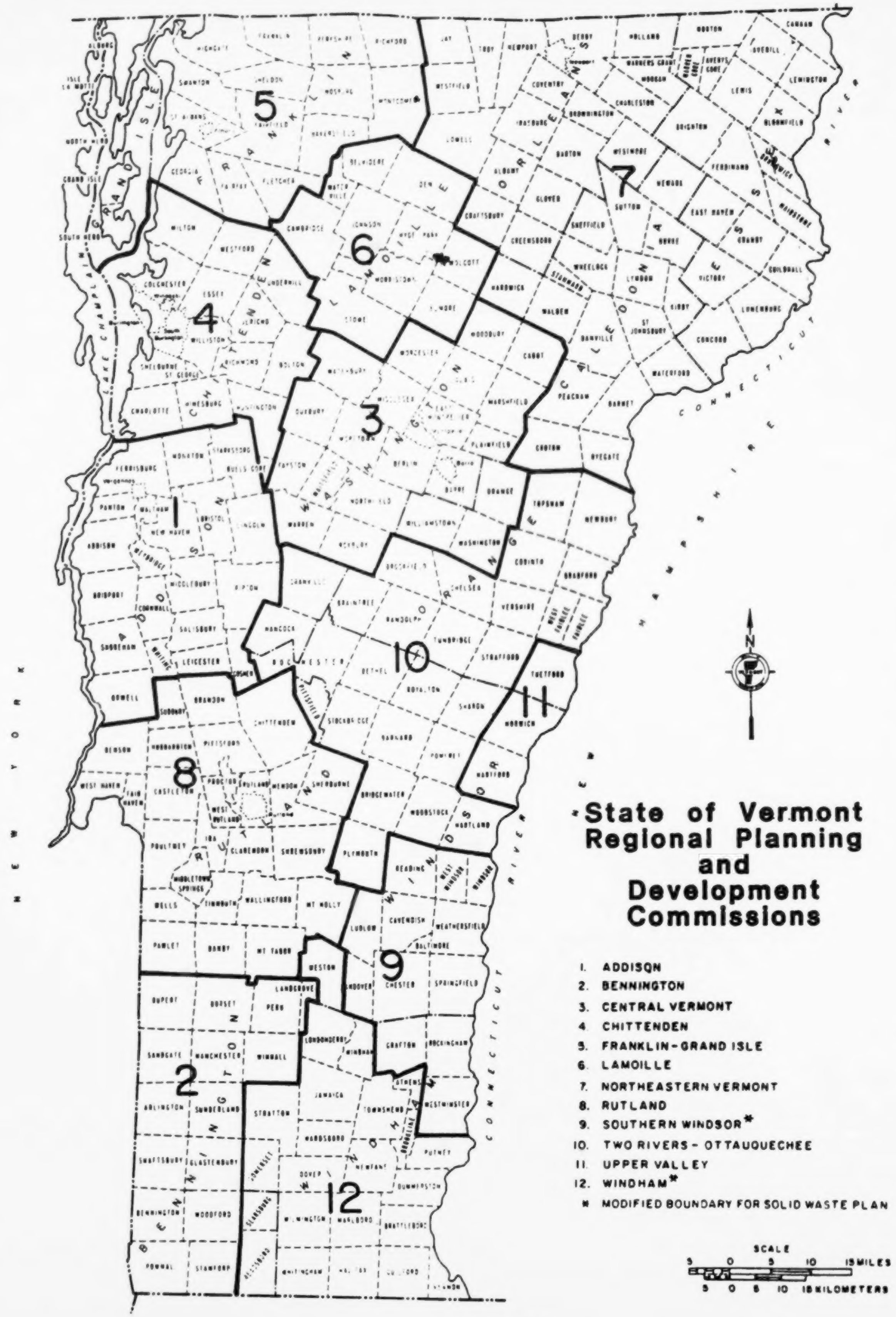
GOVERNOR'S ACTION LINE

Pavilion Office Building
Montpelier, VT 05602
(802) 828-3333
(800) 642-3131

Major Functions:
-Toll free information service concerning every phase of government.

Publications:
A Guide to the Legislative Process.

RESOURCES A.2.1 VERMONT REGIONAL PLANNING COMMISSIONS



State of Vermont Regional Planning and Development Commissions

1. ADDISON
2. BENNINGTON
3. CENTRAL VERMONT
4. CHITTENDEN
5. FRANKLIN-GRAND ISLE
6. LAMOILLE
7. NORTHEASTERN VERMONT
8. RUTLAND
9. SOUTHERN WINDSOR*
10. TWO RIVERS-OTTAUQUECHEE
11. UPPER VALLEY
12. WINDHAM*

* MODIFIED BOUNDARY FOR SOLID WASTE PLAN

RESOURCES A.2.2 VERMONT REGIONAL PLANNING COMMISSIONS

1. ADDISON COUNTY REGIONAL PLANNING AND DEVELOPMENT COMMISSION
58 North Pleasant Street
Middlebury, VT 05753
(802) 388-3141
N. Gail Byers, Executive Director
Dean Pierce, Planner and contact

MUNICIPALITIES: Addison, Bridport, Bristol Town and Village, Cornwall, Ferrisburg, Goshen, Leicester, Lincoln, Middlebury, Monkton, New Haven, Orwell, Panton, Ripton, Salisbury, Shoreham, Starksboro, Vergennes, Waltham, Weybridge, Whiting.

2. BENNINGTON COUNTY REGIONAL COMMISSION
P.O. Box 342
Arlington, VT 05250
(802) 375-2576
Gregory G. Burke, Executive Director
Nate Williams, Contact

MUNICIPALITIES: Arlington, Bennington Town and Village, Dorset, Glastenbury, Landgrove, Manchester Town and Village, North Bennington, Old Bennington, Peru, Pownal, Rupert, Sandgate, Shaftsbury, Stamford, Sunderland, Woodford.

3. CENTRAL VERMONT REGIONAL PLANNING COMMISSION
26 State Street
Montpelier, VT 05602
(802) 229-0389
Joe Bongiovanii, Executive Director
Michael Bender, Solid Waste Planner and contact

MUNICIPALITIES: Barre, Barre Town, Cabot Town and Village, Calais, Duxbury, East Montpelier, Fayston, Marshfield Town and Village, Montpelier, Orange, Plainfield Town and Village, Roxbury, Waitsfield, Warren, Washington, Waterbury Town and Village, Williamstown, Worcester, Woodbury.

4. CHITTENDEN COUNTY REGIONAL PLANNING COMMISSION
P.O. Box 108
Essex Junction, VT 05452
(802) 658-3004
Arthur R. Hogan Jr., Executive Director
Herbert Burfee, Contact

MUNICIPALITIES: Bolton, Buel's Gore, Burlington, Charlotte, Colchester, Essex, Essex Junction, Hinesburg, Huntington, Jericho Town and Village, Milton Town and Village, Richmond Town and Village, St. George, Shelburne, South Burlington, Underhill, Westford, Williston, Winooski.

5. FRANKLIN-GRAND ISLE REGIONAL PLANNING AND DEVELOPMENT COMMISSION
140 South Main Street
St. Albans, VT 05478
(802) 524-5958
Marc Jaffee, Executive Director
Jan Wells, Solid Waste Planner and contact

MUNICIPALITIES: Alburg, Bakersfield, Enosburg, Fairfax, Fairfield, Franklin, Georgia, Grand Isle, Isle La Motte, Montgomery, North Hero, Richford, St. Albans, Sheldon, South Hero, Swanton.

6. LAMOILLE COUNTY PLANNING COMMISSION
RR 1 Box 2265
Morrisville, VT 05661
(802) 888-4548
Barbara Farr, Executive Director
Dave White, Assistent Director and contact

MUNICIPALITIES: Belvidere, Cambridge, Eden, Elmore, Hyde Park, Jeffersonville, Johnson, Morristown, Morrisville, Stowe, Waterville, Wolcott.

7. NORTHEASTERN VERMONT DEVELOPMENT ASSOCIATION
P.O. Box 640
St. Johnsbury, VT 05819
Charles E. Cartar, Executive Director
Merike Petrich, Solid Waste Coordinator and contact

MUNICIPALITIES: Albany, Averill, Barnet, Barton, Bloomfield, Brighton, Brownington, Brunswick, Burke, Canaan, Charleston, Concord, Coventry, Craftsbury, Danville, Derby, East Haven, Ferdinand, Glover, Granby, Greensboro, Groton, Guildhall, Hardwick Town, Holland, Irasburg, Jay, Kirby, Lemington, Lewis, Lowell, Lunenburg, Lyndon, Lyndonville, Maidstone, Morgan, Newark, Newport, North Troy, Orleans Village, Peacham, Ryegate, St. Johnsbury, Sheffield, Stannard, Sutton, Troy, Victory, Walden, Waterford, West Glover, Westfield, Westmore, Wheelock, Warren Gore, Warner's Grant.

8. RUTLAND REGIONAL COMMISSION
P.O. Box 965
Rutland, VT 05701
(802) 775-0871
Mark Blucher, Executive Director and contact

MUNICIPALITIES: Benson, Brandon, Castleton, Fair Haven, Hubbardton, Ira, Mendon, Mt. Holly, Pawlett, Pittsford, Poultney, Proctor, Rutland, Sherburne, Shrewsburry, Tinmouth, Wallingford, Wells, West Haven, West Rutland.

9. SOUTHERN WINDSOR COUNTY REGIONAL DEVELOPMENT AND PLANNING COMMISSION
P.O. Box 88, 17 State Street
Windsor, VT 05089
(802) 674-9201
Jeff Hatling, Executive Director

MUNICIPALITIES: Andover, Baltimore, Cavendish, Chester, Ludlow, Perkinsville, Proctorsville, Reading, Springfield, Weathersfield, West Windsor, Windsor.

10. TWO RIVERS OTTAUQUECHEE REGIONAL COMMISSION
King Farm
Woodstock, VT 05091
(802) 457-3188
Don Bourdon, Executive Director
Margy Erdman, Solid Waste Planner and contact

MUNICIPALITIES: Barnard, Bethel, Bradford, Braintree, Bridgewater, Brookfield, Chelsea, Cornith, Fairlee, Granville, Hancock, Hartland, Newbury, Plymouth, Pittsfield, Pomfret, Randolph, Rochester, Sharon, Stockbridge, Strafford, Topsham, Tunbridge, Vershire, West Fairlee, Woodstock Town and Village.

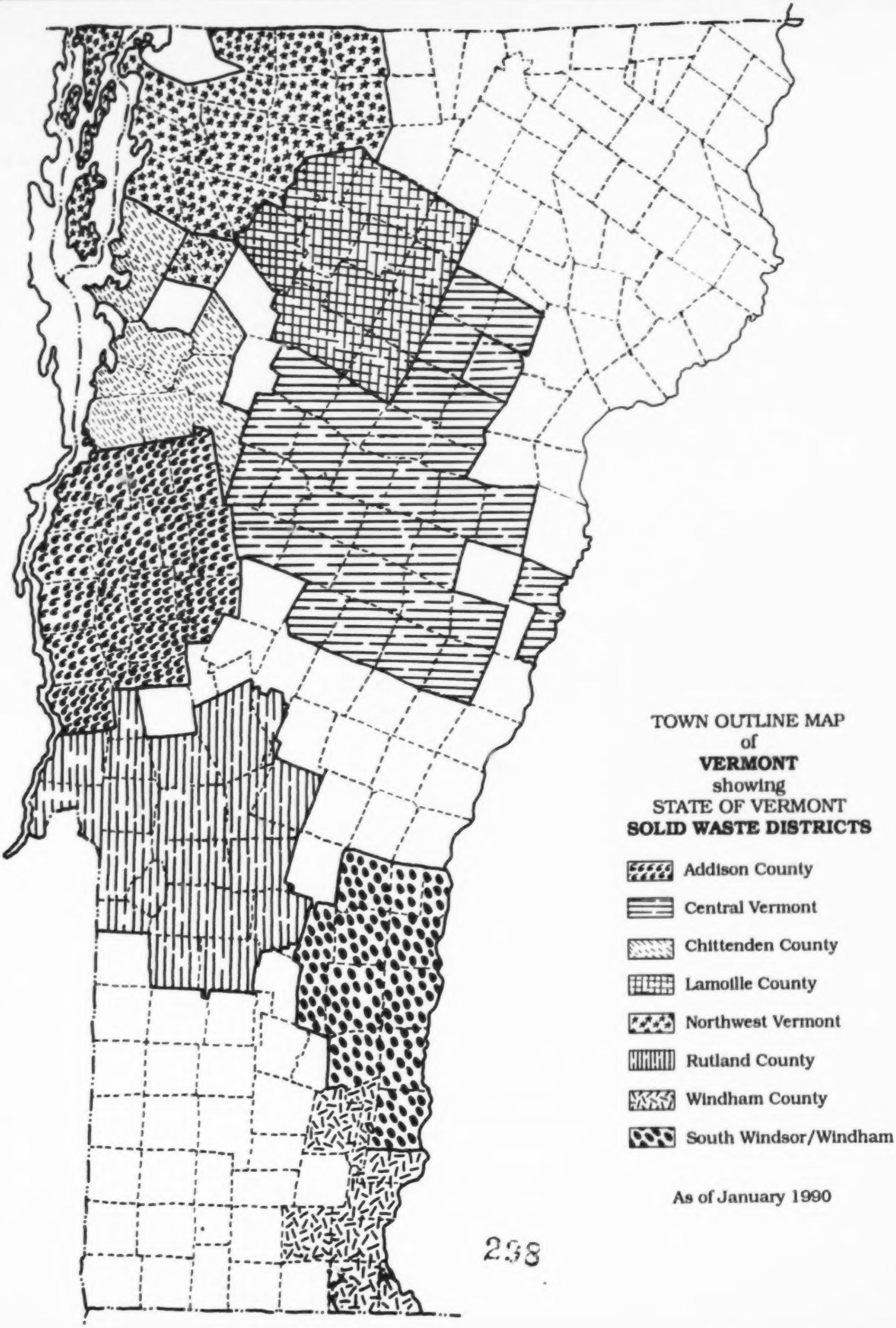
11. UPPER VALLEY LAKE SUNAPEE COUNCIL
Room 314
First NH Bank Building
Lebanon, NH 03766
(603) 448-1680
Bruce Bender, Executive Director
Judy Bowden, Contact

MUNICIPALITIES: Hartford, Norwich, Thetford, several NH towns.

12. WINDHAM REGIONAL COMMISSION
139 Main St. P.O. Box 818
Brattleboro, VT 05301
(802) 257-4547
Lew Sorenson, Executive Director
Jim Matteau, Associate Director and contact

MUNICIPALITIES: Athens, Bellow Falls, Brattleboro, Brookline, Dover, Dummerston, Grafton, Guilford, Halifax, Jamaica, Londonderry, Marlboro, Newfane Village, Putney, Readsboro, Rockingham, Stratton, Townshend, Vernon, Westminster, Weston, Whitingham, Wilmington, Windham, Windhall.

RESOURCES A.3.1 VERMONT SOLID WASTE DISTRICTS



TOWN OUTLINE MAP
of
VERMONT
showing
STATE OF VERMONT
SOLID WASTE DISTRICTS

- ▨ Addison County
- ▤ Central Vermont
- ▨ Chittenden County
- ▦ Lamoille County
- ▨ Northwest Vermont
- ▥ Rutland County
- ▨ Windham County
- ▨ South Windsor/Windham

As of January 1990

RESOURCES A.3.2 VERMONT SOLID WASTE DISTRICTS

A. ADDISON COUNTY SOLID WASTE MANAGEMENT DISTRICT
Colonial Drive RD 1 Box 275
Middlebury, VT 05753
(802) 388-2333
Steve Maier, Executive Director
Trina Stephenson, Recycling Coordinator and contact

MUNICIPALITIES: Addison, Bridport, Bristol Town, Cornwall, Ferrisburg, Leicester, Lincoln, Middlebury, Monkton, New Haven, Orwell, Panton, Ripton, Salisbury, Shoreham, Starksboro, Vergennes, Waltham, Weybridge, Whiting.

B. CENTRAL VERMONT SOLID WASTE MANAGEMENT DISTRICT
79 Main St.
Montpelier, VT 05602
(802) 229-1350
Ben Rose, Manager
Mike Raker, Recycling Coordinator and contact

MUNICIPALITIES: Barre City, Barre Town, Berlin, Bradford, Braintree, Brookfield, Cabot, Calais, Chelsea, Duxbury, East Montpelier, Fairlee, Fayston, Hardwick, Marshfield, Middlesex, Montpelier, Moretown, Northfield, Orange, Plainfield, Randolph, Roxbury, Strafford, Topsham, Tunbridge, Vershire, Waitsfield, Walden, Warren, Washington, Waterbury, Williamstown, Woodbury.

C. CHITTENDEN REGIONAL SOLID WASTE MANAGEMENT DISTRICT
400 Dorest Street
S. Burlington, VT 05401
(802) 864-0222
Paul Craven, Executive Director
Martha Sunderland, Recycling Coordinator and contact

MUNICIPALITIES: Charlotte, Colchester, Hinesburg, Huntington, Jericho, Milton, Richmond, Shelburne, South Burlington, St. George, Williston, Winooski City, Westford.

D. LAMOILLE REGION SOILD WASTE MANAGEMENT DISTRICT
Box 2264 RR 1
Morrisville, VT 05661
(802) 888-7317
Theresa White, District Manager
Bill Moore, Planner and contact

MUNICIPALITIES: Belvidere, Cambridge, Craftsbury, Elmore, Eden, Hyde Park, Johnson, Morrisville, Stowe, Waterville, Wolcott, Worcester.

E. NORTHWEST VERMONT SOLID WASTE MANAGEMENT DISTRICT
P.O. Box 1547
St. Albans, VT 05478
(802) 524-5986
Katherine Vose, Executive Director
Mary Gillilan, Public Information Coordinator and contact

MUNICIPALITIES: Alburg Town and Village, Bakersfield, Berkshire, Enosburg, Enosburg Falls, Fairfax, Fairfield, Fletcher, Franklin, Georgia, Grand Isle, Montgomery, North Hero, Richford Town and Village, St. Albans City and Town, Sheldon, South Hero, Swanton Town and Village, Westford.

F. RUTLAND COUNTY SOLID WASTE DISTRICT
P.O. Box 965
The Opera House
Rutland, VT 05701
(802) 775-6482
Michael Samson, Director
Rick Foote, Manager and contact

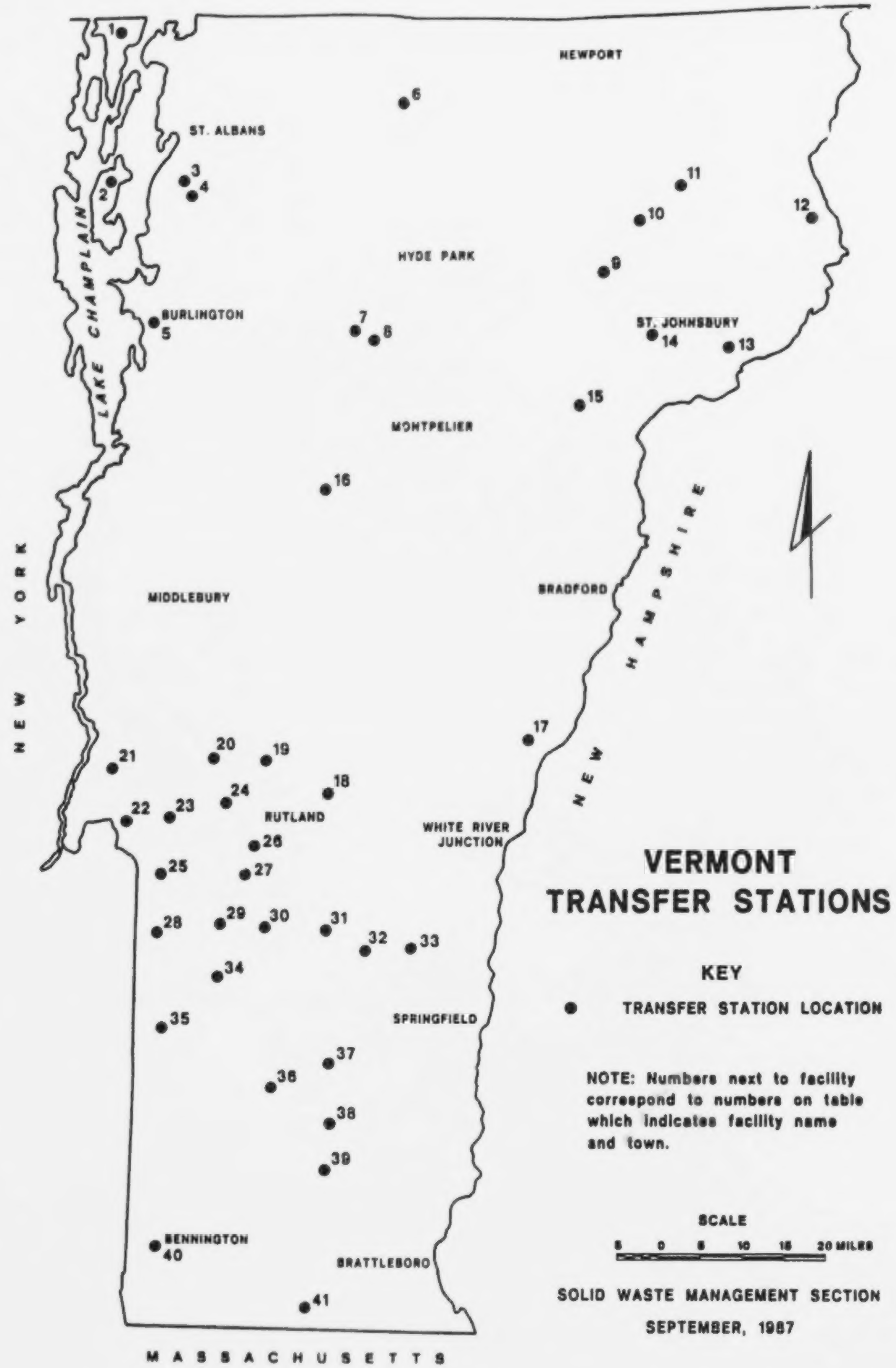
MUNICIPALITIES: Benson, Castleton, Chittenden, Clarendon, Danby, Hubbardton, Ira, Mendon, Middletown Springs, Mount Holly, Mt. Tabor, Pittsfield, Poultney, Proctor, Rutland City, Shelburne, Shrewsbury, Sudbury, Tinmouth, Wallingford, Wells, West Rutland.

G. SOUTHERN WINDSOR/ WINDHAM COUNTY SOLID WASTE MANAGEMENT DISTRICT
c/o NH/VT Solid Waste Projec
Room 336, Moody Building
Claremont, NH 03743
(603) 543-1201
John Cook, Project Manager
Carl Hirth, Solid Waste Planner and contact

MUNICIPALITIES: Andover, Baltimore, Cavendish, Chester, Grafton, Ludlow, Reading, Rockingham, Springfield, Weathersfield, Westminster, West Windsor, Windsor.

H. WINDHAM COUNTY SOLID WASTE MANAGEMENT DISTRICT
P.O. Box 6427
Brattleboro, VT 05301
(802) 257-0272
Steve Johnson, Executive Director and contact

MUNICIPALITIES: Brattleboro, Brookline, Dummerston, Guilford, Marlboro, Putney, Townshend, Vernon, Whitingham (pending).



VERMONT TRANSFER STATIONS

KEY

● TRANSFER STATION LOCATION

NOTE: Numbers next to facility correspond to numbers on table which indicates facility name and town.

SCALE

5 0 5 10 15 20 MILES

SOLID WASTE MANAGEMENT SECTION

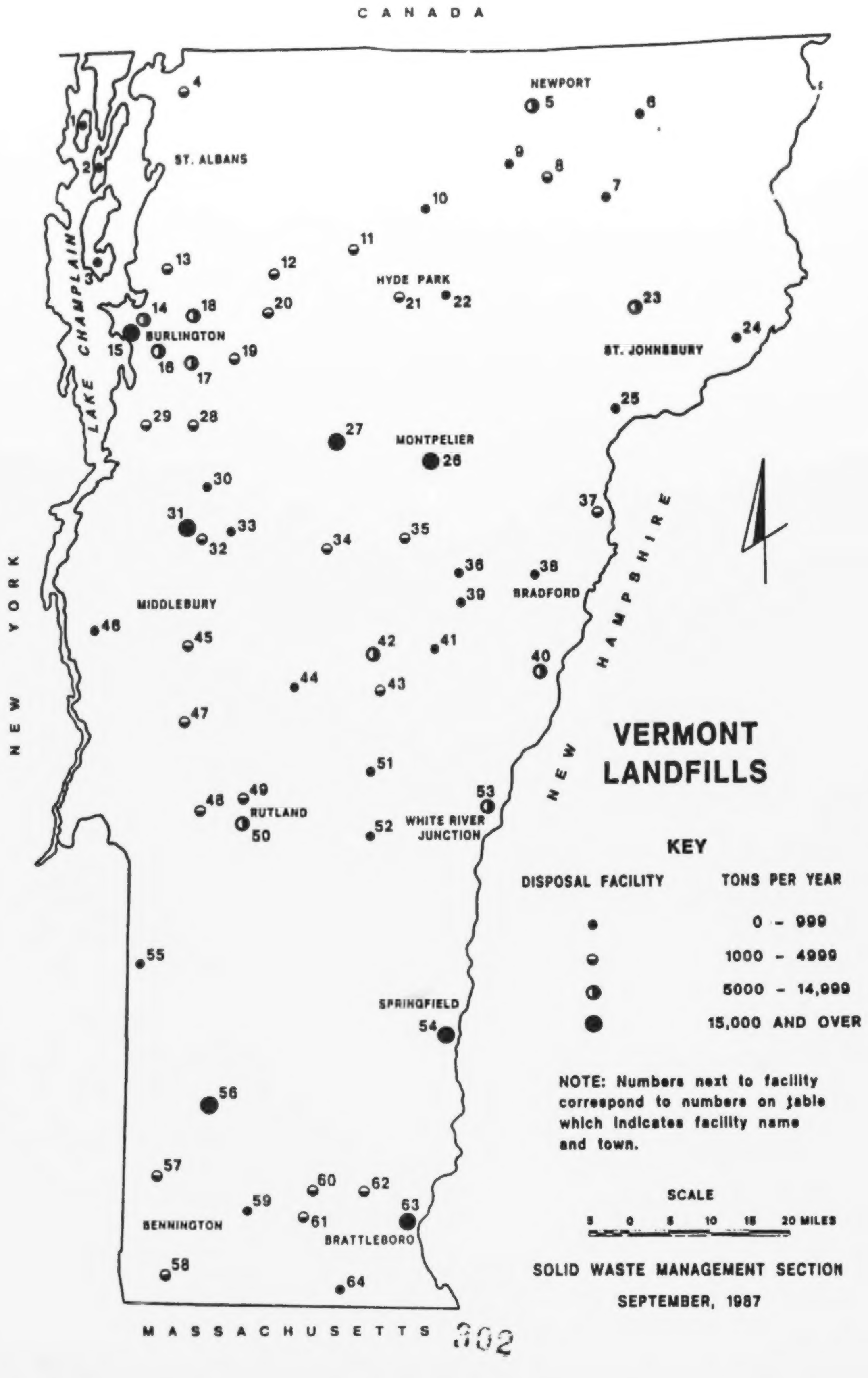
SEPTEMBER, 1987

Vermont Transfer Stations by Region (Town and Private) - 1987

			DESCRIPTION		
Region	Map No.	Transfer Station Name	Type	Landfill Used	On-Site Stump Dump
2	35	Rupert	Rolloff	Vicon-Sunderland	No
2	36	Winhall	Compactor	Vicon-Sunderland	No
2	40	Vicon-Bennington	Compactor	Vicon-Sunderland	No
3	16	Trash Unlimited-Waitsfield	Compactor	Palisades	No
4	5	Univ. of Vermont-Burlington	Bulky Waste	Burlington	No
5	1	Alburg	Compactor	Palisades	Yes
5	2	Grand Isle	Compactor	Palisades	No
5	3	Georgia	Dumpsters	Central Vermont	Yes
5	4	Georgia Commercial	Compactor	Central Vermont	No
5	6	Towns-Montgomery	Compactor	Central Vermont	Yes
6	7	Stowe-Town Road #50	Bulky Waste	Central Vermont	No
6	8	Stowe-Route 108	Compactor	Palisades	No
7	9	Wheelock	Dumpster	Parker	No
7	10	Sutton	Dumpster	Parker	No
7	11	Newark	Dumpsters	Parker	No
7	12	Maidstone	Dumpster	Parker	No
7	13	Concord	Dumpster	Parker	No
7	14	St. Johnsbury	Dumpsters	Parker	No
7	15	Peacham	Dumpster	Parker	No
8	18	Sherburne	Dumpster	Vicon-Bristol	Yes
8	19	Chittenden	Rolloff	Vicon-Bristol	Yes
8	20	Pittsford	Compactor	Vicon-Bristol	Yes
8	21	Benson	Rolloff	Vicon-Bristol	Yes
8	22	Fair Haven	Compactor	Vicon-Bristol	No
8	23	Castleton	Compactor	Vicon-Bristol	No
8	24	Proctor	Rolloff	Vicon-Bristol	No
8	25	Poultney	Compactor	Vicon-Bristol	Yes
8	26	Hubbard #1-Rutland	Compactor	Rutland Town	No
8	27	Clarendon	Compactor	Vicon-Bristol	No
8	28	Wells	Dumpster	Granville, N.Y.	No
8	29	Tinmouth	Rolloff	Vicon-Bristol	No
8	30	Wallingford	Rolloff	Vicon-Sunderland	No
8	31	Mt. Holly	Compactor	Vicon-Bristol	Yes
8	34	Danby	Rolloff	Vicon-Sunderland	No
9	32	Ludlow	Compactor	Gobin, N.H.	Yes
9	33	Cavendish	Compactor	Claremont, N.H.	Yes
11	17	Norwich	Dumpsters	Barker	Yes
12	37	Vicon-Londonderry	Compactor	Vicon-Sunderland	No
12	38	Jamaica	Compactor	B.F.I.	Yes
12	39	Wardsboro	Compactor	Massachusetts	Yes
12	41	Whitingham	Compactor	Massachusetts	Yes

* Does not include mobile transfer/collection facilities at Williamstown and Woodbury.

Source: State of Vermont Solid Waste Plan



VERMONT LANDFILLS

KEY

DISPOSAL FACILITY	TONS PER YEAR
•	0 - 999
◒	1000 - 4999
◑	5000 - 14,999
●	15,000 AND OVER

NOTE: Numbers next to facility correspond to numbers on table which indicates facility name and town.

SOLID WASTE MANAGEMENT SECTION
SEPTEMBER, 1987

Region	Map No.	Landfill Name (Town or Private [*])	1980 Pop. Served	Location (Vt. Town)	Current Use Rate <1000T/Yr.
1	30	Starksboro	1,336	Starksboro	X
1	31	Vicon-Bristol (*)	31,786	Bristol	
1	32	Bristol	3,293	Bristol	
1	33	Lincoln	870	Lincoln	X
1	45	Salisbury	4,479	Salisbury	
1	46	Bridport	997	Bridport	X
2	56	Vicon-Sunderland (*)	34,070	Sunderland	
2	57	Shaftsbury	3,001	Shaftsbury	
2	58	Pownal	3,269	Pownal	
3	34	Gross (*)	5,892	Roxbury	
3	35	Williamstown	2,284	Williamstown	
3	36	Washington	855	Washington	X
3	26	C.V. (*)	59,341	E. Montpelier	
3	27	Palisades (*)	26,839	Moretown	
4	28	Hinesburg	5,849	Hinesburg	
4	29	Charlotte	2,561	Charlotte	
4	13	Milton	6,829	Milton	
4	14	Rathe Bros. (*)	25,111	Colchester	
4	15	City of Burlington	37,712	City of Burlington	
4	16	South Burlington	10,679	South Burlington	
4	17	Williston	4,320	Williston	
4	18	Essex	14,392	Essex	
4	19	Jericho	3,575	Jericho	
4	20	Underhill	2,172	Underhill	
5	1	Isle La Motte	393	Isle La Motte	X
5	2	North Hero	442	North Hero	X
5	3	South Hero	1,188	South Hero	X
5	4	Highgate	2,493	Highgate	
6	10	Eden	612	Eden	X
6	11	Johnson	2,581	Johnson	
6	12	Cambridge	2,489	Cambridge	
6	21	Lamoille (*)	6,087	Morristown	
6	22	Wolcott	986	Wolcott	X
7	23	Parker (*)	30,370	Lyndon	
7	24	Lunenburg	1,138	Lunenburg	X
7	25	Barnet	1,338	Barnet	X
7	5	Nadeau (*)	14,940	Coventry	
7	6	Morgan	1,311	Morgan	X
7	7	Westmore	257	Westmore	X
7	8	Barton	4,541	Barton	
7	9	Irasburg	870	Irasburg	X
8	47	Brandon	4,194	Brandon	
8	48	West Rutland	2,351	West Rutland	
8	49	Rutland Town	3,300	Rutland	
8	50	Rutland City	19,492	City of Rutland	
8	55	Pawlet	1,244	Pawlet	X
9	54	Browning Ferris Industries (*)	6,973	Rockingham	
10	51	Barnard	790	Barnard	X
10	52	Bridgewater	867	Bridgewater	X
10	37	Leete-Powers (*)	12,110	Newbury	
10	38	Hayward (*)	1,671	Corinth	X
10	39	Chelsea	1,091	Chelsea	X
10	41	Tunbridge	925	Tunbridge	X
10	42	Randolph	6,713	Randolph	
10	43	Bethel	4,545	Bethel	
10	44	Twitchell (*)	1,850	Rochester	X
11	40	Barker (*)	8,245	Thetford	
11	53	Hartford	16,020	Hartford	
12	59	Searsburg	72	Searsburg	X
12	60	Dover	666	Dover	
12	61	Wilmington	1,806	Wilmington	
12	62	Newfane	1,129	Newfane	
12	63	Brattleboro	19,871	Brattleboro	
12	64	Halifax	488	Halifax	X

* Indicates private landfill.

Source: State of Vermont Solid Waste Plan

VICON RESOURCE RECOVERY FACILITY
P.O. Box 854, Green Hills Lane
Rutland, VT 05701
(802) 773-1365
Rick Kelley, Jr., Project Manager

Resources available for Third Grade through Adults include: some publications, some audiovisuals and in-service speakers, slide presentations and workshops.

WHEELABRATOR WASTE-TO-ENERGY PLANT
Claremont, NH

Contact:

Al Haley
P.O. Box 1466
Claremont, NH 03743
(603) 542-8764

OR John Cook or Carl Hirth at:
NH/VT SOLID WASTE PROJECT
Room 336, Moody Building
Claremont, NH 03743
(603) 543-1201

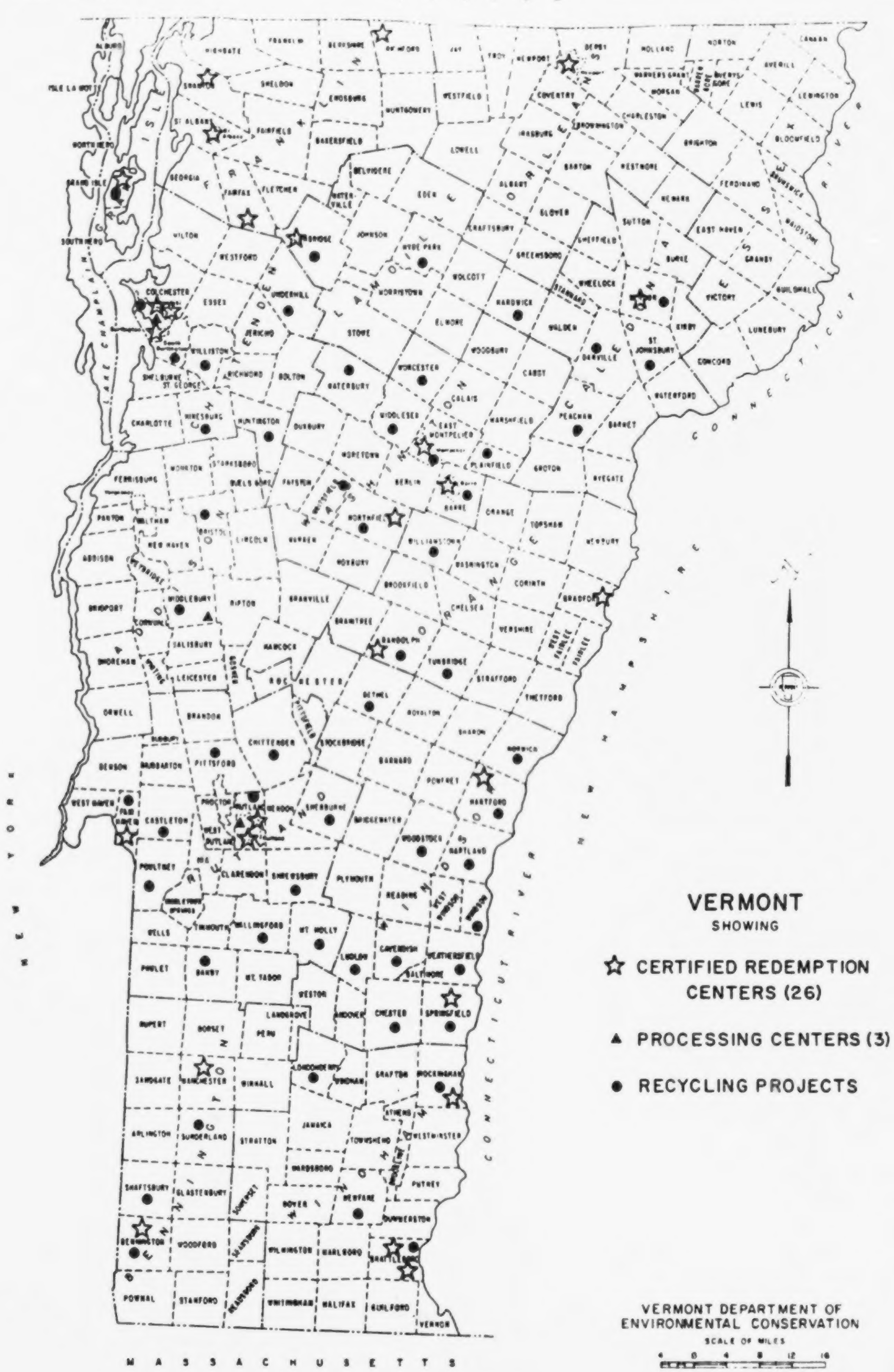
VICON RECOVERY SYSTEMS
500 Hubbard Avenue
Pittsfield, MA 01201
(413) 443-7373

KTI ENERGY
4 City Center
Portland, ME 04101
(207) 871-9224

LAMPREY SOLID WASTE COOPERATIVE
Durham, NH 03824
(603) 868-1068
Contact: Dick Rugg

A.7 PLACES TO RECYCLE

(Call the State of Vermont Recycling Hotline, 1-800-932-7100, to obtain most recent directory of places to recycle in Vermont.)



A.8 VOLUNTEER RECYCLING GROUPS

The following is a partial list of volunteer recycling organizations. For a complete list refer to the Vermont Agency of Natural Resources' *Directory of Vermont Recycling Collection Programs.*

ADDISON COUNTY

Cornwall Recycling Committee
Steve Reynolds
RD 2 Box 2632
Middlebury, VT 05753
(802) 462-2556

Middlebury Recycling Committee
Daniel Barberis
RD 1 Middlebury E #4E
Middlebury, VT 05753
(802) 388-3113

BENNINGTON COUNTY

Shaftsbury Recycling Committee
Rob Costantino
RR 2 Box 93
Shaftsbury, VT 05262
(802) 442-9162

CALENDONIA COUNTY

Peacham Solid Waste Committee
Betsey McKay
P.O. Box 80
Peacham, VT 05862
(802) 592-3366

CHITTENDEN COUNTY

Richmond Recycling Committee
Lori Grizwyna
RR 2 Box 238
Richmond, VT 05477
(802) 434-3013

Williston Recycling Committee
Linda McElvany
20 Sundown Dr.
Williston, VT 05495
(802) 878-8605

FRANKLIN COUNTY

Montgomery Recycling Committee
Barry Cade
Box 55
Montgomery, VT 05470
(802) 933-4969

GRAND ISLE COUNTY

Grand Isle Conservation Committee
Eric Henning
RR 1 Box 690
Grand Isle, VT 05458
(802) 372-5274

ORANGE COUNTY

Randolph Recycling Committee
Fred Kosnitsky
2 Vocon Dr.
Randolph, VT 05060
(802) 728-3786

RUTLAND COUNTY

Chittenden Recycling Committee
Kathy Hall
Box 49, Mountain Top Rd.
Chittenden, VT 05737
(802) 483-2979

Tinmouth Recycling Committee
Kathy Reynolds
RR 1 Box 428A
Wallingford, VT 05773
(802) 446-2928

WASHINGTON COUNTY

Waitsfield Recycling Committee
Marge Keough
RR 1 Box 2120
Moretown, VT 05660
(802) 496-4566

WINDHAM COUNTY

Rockingham Recycling Committee
Michael Veitch
RR 2 Box 358
Chester, VT 05143
(802) 463-4383

WINDSOR COUNTY

Bethel/Royalton Recycling Committee
Del Cloud
Town Office
Bethel, VT 05032
(802) 234-9340

ASSOCIATED INDUSTRIES OF VERMONT
100 State Street
Montpelier, VT 05602
(802) 223-3441
Contact: Kerrick Johnson

Membership organization. WASTE-CAP: Volunteer group of business personnel who suggest waste reduction and recycling programs for businesses.

BLACK LIGHTENING
RR 1, Box 87
Depot Road
Hartland, VT 05048
(802) 436-3257
Contact: Walter Jefferies

Recycles lazer printer cartridges.

BURLINGTON WASTE AND METAL
255-25 North Winooski Avenue
P.O. Box 73
Burlington, VT 05402
(802) 862-5335
Contact: Howard Klinkostein

Scrap metal recycling.

CASELLA WASTE MANAGEMENT
P.O. Box 866
Rutland, VT 05702
(802) 775-0325
Contact: Lee Diamond

Recycling and waste hauling services. Classroom presentations. Tours available of Rutland recycling facility.

CENTRAL VERMONT PUBLIC SERVICE CORPORATION
77 Grove Street
Rutland, VT 05702
(802) 773-2711
(800) 622-4141 (In Vermont)
Contact: Diane DeSantis

Film and video library covering energy and conservation issues. Contact for free catalog.

RECYCLING SERVICES, INC.
P.O. Box 305
Claremont, NH 03743
(603) 542-8755
Contact: Jim Silvers

Recycling facility. Tours available.

COCA-COLA BOTTLING COMPANY
Hercules Drive
Colchester, VT 05404
(802) 655-9660
Contact: David Larose, Branch Manager

Tours available.

CPM INC.
Box 95
East Ryegate, VT 05042
(802) 757-3353
Contact: Philip Basch, Plant Manager

Paper mill. Tours available.

NEW ENGLAND CRInc.
175 Lakeside Avenue
Burlington, VT 05401
(802) 862-1900
George Bessett, Manager
Contact: Art Rossetti

Recycling facility. Tours, classroom presentations and assistance in setting up recycling programs available.

ENERGY INFORMATION CENTER AT VERMONT YANKEE
Box 157, Governor Hunt Road
Vernon, VT 05354
(800) 248-9015 (in Vermont) or (802) 257-1416 collect.
Contacts: Barbara Martocci or Linda Zinn

E.I.C. maintains lending library of over 500 volumes and audiovisuals on energy topics including high and low-level radioactive waste and energy conservation (Call for a free copy of their Educator's Resource List). Tours and classroom presentations available.

EVEREADY BATTERY COMPANY
Box 671
St. Albans, VT 05478
(802) 524-2151
Contact: Charles Parietti, Plant Manager

Produces flashlights and battery components. Tours available.

GARDENER'S SUPPLY
Intervale Road
Burlington, VT 05401
(802) 863-1700
Contact: Paul Zabriskie

Tours available of leaf composting operation. It is suggested that these be scheduled during windrow operation.

GREEN MOUNTAIN POWER CORPORATION
25 Green Mountain Drive
P.O. Box 850
South Burlington, VT 05402
(802) 864-5731
Contact: Gregg Morgan

Tours of hydroelectric power plants in Waterbury, Vergennes and Essex.

HARDWICK RECYCLING AND SALVAGE
P.O. Box 308, Stafford Street
Morrisville, VT 05661
(802) 888-3627
Contact: Marci Towns

Recycling and hauling services. Classroom presentations, school recycling program assistance, and recycling facility tours available.

HIGH PERFORMANCE SYSTEMS
13 Dartmouth College Highway
Lyme, NH 03768
(603) 795-4122

Computer software programs sutiable for modelling landfill capacity.

NORTHEAST WASTE SERVICES
Woodstock Road
P.O. Box 1045
White River Junction, VT 05001
(802) 295-9353
Contact: Liz McIntyre

Recycling and hauling services. Classroom presentations and school recycling program assistance.

PEPSI BOTTLING COMPANY
20 Karen Drive
South Burlington, VT 05403
(802) 864-6000
Contact: Tim Bourgeois, Production Manager

Bottling facility. Tours available.

PUTNEY PAPER COMPANY
P.O. Box 26
Hinsdale, NH 03451
(802) 387-5571
Contact: Frank Taratino

Produces napkins and wrapping tissues using 100% preconsumer recycled fibers from New England mills. Tours may be available for older students.

RESTORE RESOURCES, UNLIMITED
18 Cross Street
Montpelier, VT 05602
(802) 229-0102
Contact: Connie Leach

Waste reduction business rescuing discarded objects from the waste stream.

SEVEN-UP BOTTLING CO., INC. OF RUTLAND
Quality Lane
Cold River Industrial Park
Rutland, VT 05701
(802) 773-9677

Tours available.

SEVENTH GENERATION
10 Farrell Street
South Burlington, VT 05403
(800) 456-1177

"Products for a healthy planet" including recycled paper products, recycling bins, biodegradable cleaning products and energy-efficient fixtures.

SIMON PEARCE
The Mill
Quechee, VT 05059
(802) 295-2711
Contact: Martha Dickerson

Hydroelectric-powered mill. Manufacture of hand-blown glassware. Tours of the glassblowing operation are available, preferably for less than twenty students.

TUNBRIDGE GLASSWORKS
Route 110
Tunbridge, VT 05077
(802) 889-3430
Contact: Susan Dollerimaier

Manufacture of hand-blown functional glassware. Tours are available for less than ten students at one time.

VAN-BEC RECYCLING
East Middlebury, VT 05740
(802) 388-9522
Contact: Rebecca Stude-Price

Recycling facility.

VERMONT IMPORTANT PAPER
Box 90
Cuttingsville, VT 05738
(802) 492-3304
Contacts: Eldrid and Lilly French

Sale of recycled paper products; printing services.

VERMONT NEWSPAPER RECYCLING CENTER
13 Portland Street
St. Johnsbury, VT 05819
(802) 748-3637
Contact: Jose Perrault

Recycling facility. Tours and classroom presentations available.

VERMONT REPUBLIC INDUSTRIES
3 Lemnah Drive
P.O. Box 521
St. Albans, VT 05478-1521
(802) 524-6055
Contact: Albin Voegele, President

Plastics recycling plant which employs "handicapped" workers. Tours of the plant are encouraged. On a very limited basis, VRI is able to provide presentations on plastics recycling.

VERMONT RETAIL ASSOCIATION
P.O. Box 688
Essex Junction, VT 05452-0688
(802) 879-6999
Contact: Karen Robinson

VERMONT RURAL RECYCLERS
P.O. Box 5
Marshfield, VT 05658
(802) 426-3793
Contact: Tim O'Rourke

Paper shredding and animal bedding.

RESOURCES A.10.1 ENVIRONMENTAL AND RESOURCE GROUPS

ASSOCIATION OF VERMONT RECYCLERS
P.O. Box 1244
Montpelier, VT 05601
(802) 229-1833
Contact: Glenn McRae, Director

Publications:
Out of the Dumps, membership quarterly ($15); *Re-Act!*, teacher's newsletter (free with AVR membership); *Recycling Planner*, monthly update for recycling community ($12); *AVR Teacher's Guide For Solid Waste and Recycling Education* (free to teachers attending AVR workshops).

Programs:
Annual recycling conferences presenting speakers, workshops and exhibits on various local and national recycling issues; technical assistance on recycling planning and marketing cooperatives; teacher-training workshops on solid waste and recycling; rental of a teacher's traveling resource center containing books, videos and large illustrated panels; technical assistance on setting up a successful school recycling program.

ENVIRONMENTAL LAW CENTER
Vermont Law School
South Royalton, VT 05068
(802) 763-8303
Contact: Leslie Staudinger

Resources:
Many publications on environmental issues including student and faculty research papers on solid waste, incineration, risk assessment and recycling.

Programs:
Workshops for adults; summer graduate studies in environmental law.

ENVIRONMENTAL LAW FOUNDATION
26 State Street
Montpelier, VT 05602
(802) 229-6300
Contact: Frank Reed, Director

Focus:
Membership organization focusing on education and research in environmental law and policy.

EARTHRIGHT INSTITUTE
Gates-Briggs Building, Room 322
White River Junction, VT 05001
(802) 295-7734
Contacts: Sami Izzo, Bob Walker

Focus:
Upper Connecticut River Valley region environmental issues; resource and referral center.

Publications:
Chicken Little Chronicle, monthly membership newsletter ($25).

LAKE CHAMPLAIN COMMITTEE
14 South Williams Street
Burlington, VT 05401
(802) 658-1414
Contact: Lori Fisher, Director

Focus:
Protection of natural resources of Lake Champlain and its watershed. Research, advocacy and public education programs.

Publications:
Lake Champlain Committee Newsletter, triannual membership newsletter ($25).

MONTSHIRE MUSEUM
P.O. Box 770
Montshire Road
Norwich, VT 05055
(802) 649-2200
Contact: Delia Clark, Public Issues Program Manager

Focus:
Science museum offering hands-on exhibits and education programs for schools and community members. The Public Issues Program serves to inform and empower the public in the realms of science, technology and the environment through coordinating community forums and helping local organizations.

Publications:
Quarterly memberhip newsletter ($25).

NATIONAL GARDENING ASSOCIATION
180 Flynn Avenue
Burlington, VT 05401
(802) 863-1308

Resources:
"Grow Lab" indoor gardening kits and gardening programs available for children.

UNIVERSITY OF VERMONT EXTENSION SERVICE
Morrill Hall
Burlington, VT 05405
(802) 656-2990
Contact county offices for local programs.

Publications:
Hazardous Materials In Your Home, brochure.

VERMONT GREEN UP, INC.
One Baldwin Street
P.O. Box 1191
Montpelier, VT 05602
(802) 229-4586
Contact: Nancy Johnson, Director

Focus:
Waste reduction and anti-litter campaign.

Resources:
Swamp Thing psa video by Greenpeace for loan. Classroom presentations available.

VERMONT NATURAL RESOURCES COUNCIL
9 Bailey Avenue
Montpelier, VT 05602
(802) 223-2328
Contact: Susan Clark

Southern Branch Office
Bonnet Street
Box 2021
Manchester Center, VT 05255
(802) 362-3113

Focus:
Statewide research, education and advocacy organization working to promote the wise use of Vermont's natural resources. Vermont affiliate of National Wildlife Federation.

Publications:
Vermont Environmental Report, quarterly membership magazine ($20); Curriculum on Tropical Rain Forests; *VNRC Bulletin*, periodic (free with membership); *Vermont Environmental Directory* ($5/members, $10/non-members plus $1 postage); Citizens Involvement Kit.

Programs:
Maintains library of literature and periodicals covering solid and hazardous waste topics and other environmental issues. Coordinates National Wildlife Week and annual distribution of National Wildlife Week Kits to schools statewide.

VERMONT POISON CENTER
Medical Center Hospital of Vermont
Burlington, VT 05401
(802) 656-3721 Information
Emergency Hotline:
(802) 658-3456 (24 hrs/day)
Contact: Joan Martin, Education Coordinator

Information:
Ingredients of commercial formulations, toxicity of natural products such as plants and mushrooms, toxicity of drugs, probability of toxic effects from quantity injected, initial treatment recommendations, and recommendations for further treatment when required.

Programs:
"Mr. Yuk" programs, teaching poison prevention for all age levels are offered to day care centers, schools, organizations and businesses. Stickers and materials available.

Resources:
Computer and microfiche information; up-to-date journals and files concerning the toxicity of drugs and natural and commercial products; extensive local and national consultants.

VERMONT PUBLIC INTEREST RESEARCH GROUP
43 State Street
Montpelier, VT 05602
(802) 223-5221
Contact: Joan Mulhern, Legislative Director

Publications:
VPIRG UPDATE, quarterly membership newsletter containing news articles and featuring a variety of environmental and consumer issues including solid waste and recycling.

Programs:
Speakers available on a variety of topics, including solid waste, recycling, incineration, hazardous waste, groundwater and other environmental issues (e.g. pesticides, nuclear issues, etc.).

VERMONT SIERRA CLUB
24 Beacon Street
South Burlington, VT 05401
(802) 656-4336
Contact: George Webb, Chairman

VERMONTERS ORGANIZED FOR CLEAN UP
289 North Main Street, 2nd Floor
Barre, VT 05641
(802) 476-7757
Contacts: Theresa Freeman/ Pam Peck

Publications:
Right to Know Paper (grades 7-12); quarterly membership newsletter ($15).

Audio-visuals:
Toxic Time Bomb. HBO Documentary, (grades 6-12), $25.

Programs:
Presentations can be adapted for grades 5-12. What citizens can do about toxic waste; History of grassroots movement on environmental issues in Vermont; Styrofoam--problems and solutions. Fee is $25 for visit plus $.21/mile.

Tackle the Trash Problem

WITH

"WASTE AWAY"

An Educational Program From The Vermont Institute of Natural Science
P. O. Box 86, Woodstock, Vermont 05091, (802) 457-2779

> ***Everyone knows that trash is the talk of the town.***
> ***"THROW IT AWAY, BURY IT, BURN IT--GET RID OF IT!"***
> ***BUT WHERE? There's no such place as AWAY.***
> ***What CAN you do? Bring "WASTE AWAY" to your classroom and community.***

What is it?	**An exciting program for 5th - 6th grade children (may be appropriate for other grades also) beginning fall of 1989! Hands-on activities, experiments, simulation games and interviews will teach them about trash problems and help them come up with solutions for their classroom, their homes, their school, and their communities.**
How does it work?	**VINS staff, classroom teachers and parent volunteers will work together to teach children in the classroom and outdoors. From a single classroom, activities and information will permeate throughout the school! A culminating school/community Trash Festival will show everyone how to tackle the trash problem.**
What does it include?	**-- Teacher/Volunteer Manual with information and sequenced activities including follow-up and on-going activities** **-- Booklet for families** **-- Teacher/Volunteer training** **-- Materials--audiovisual and others needed for activities** **-- 4 classroom sessions over a two-month period with VINS staff** **-- How-to's for Trash Festival**
What does it cost?	**$1500 per Waste Away project. Contact VINS for suggestions for funding assistance.**
How do we apply?	**Call or write VINS for application form. Classrooms will be selected based on teacher/community interest and volunteer support.**

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The Vermont Institute of Natural Science is a non-profit membership organization dedicated to environmental education and natural history research.

Food Works
64 Main Street
Montpelier, VT 05602
(802) 223-1515
Joseph Kiefer, Director

Food Works is currently researching and developing a statewide comprehensive K-6 curriculum for food growing, nutrition, ecology and community service. Our third grade year is specifically about soil and community. Students will study and construct a compost system. We offer In-Service Teacher Trainings, classroom activity modeling, and can facilitate a school-wide master plan for composting and thematic community/school gardens.

David Ehrlich
RR 1 Box 50
Randolph, Vt 05060
(802) 234-5401

Vermont Council on the Arts offers this residency in film animation. In addition to completing their own project, students participate in several group projects. Introductory film and demonstration for the entire school are included. Teacher workshop and final community animation festival negotiable. Priority given to two week residencies with 2 two-hour classes.

David Ehrlich and the Newark Street School of West Burke, VT completed an animated film on solid waste in 1988. Two of its animation artists toured with the film in Europe as part of an international animation film project focusing on the environment.

Garbagio
c/o Nancy Bell
RFD
Shrewsbury, VT 05738
(802) 773-3368

"Garbagio" helps students learn about recycling and carry the earth while clowning around. Garbagio will bring environmental games to the classroom, while providing practical instruction and curriculum assistance for teachers.

Stu McGowan
97 Hayward Street
Burlington, VT 05401
(802) 862-8639

This Vermont Council on the Arts residency teaches students to use video to further understand television and its effects. Emphasis is placed on conventional use of video (television production) and includes a segment on experimental uses. Students learn the medium through fun exercises which prepare them for the final project: a video about their town. After spending several days videotaping people, places and events, students then edit segments into a final show for public access or WCAX-TV.

Stu McGowan recently produced a solid waste management video with the 7th and 8th graders of the Bethel/Royalton High Schools. The video documented garbage composition and generation, problems with wildlife, biodegradability and litter, and attitudes about waste problems.

Jeremy Seeger
Box 117
Fassett Hill
Hancock, VT 05401
(802) 767-3790

Students explore basic techniques of making paper by hand. Materials such as wood pulp, recycled paper, and natural materials (grasses, seeds, etc) are used to create new paper. Other craft workshops (Book Making, Marbleizing) are available. Residencies available through Vermont Council on the Arts.

Matt Witten
P.O. Box 145
Huntington, VT 05462
(802) 434-3501

Matt helps students understand recycling and solid waste issues through music, puppet shows, games and discussions. His presentations are designed to provoke thought and spark enthusiasm for school recycling programs. Individual class presentations and a full school assembly are included in this program.

Vermont Institute of Natural Science
P.O. Box 86
Woodstock, VT 05091
(802) 457-2779
Contact: Bonnie Ross

Too Much Trash is a one-hour presentation featuring hands-on activities, demonstrations, and a slide show. This program explains the solid waste challenge and our role in meeting that challenge. *Too Much Trash* is designed for third grade and above and is available for $90.

Residential Solid Waste Workshop

This three-day summer workshop offers teachers an opportunity to acquire new teaching ideas and useful knowledge about solid waste issues. Dissecting a package, starting a class compost pile and visiting a landfill are all included in this workshop. Graduate credit may be available. (Not offered every year.)

Waste Away

See description on previous page. In addition to the school program, the *Waste Away Curriculum Guide* is available for sale from VINS for $18.95 plus $2.50 p&h. Inservice programs in using the guide are also available for $100/hour or $400/day. Contact VINS for more information.

State-Wide Environmental Education Programs (SWEEP)
c/o Vermont Natural Resources Council
9 Bailey Avenue
Montpelier, VT 05602
(802) 223-2328
Contact: Susan Clark

SWEEP is a coalition of environmental organizations and people promoting environmental education in Vermont. SWEEP acts as a resource exchange network. A directory of member organizations and the various environmental education programs they offer is available upon request.

Appropriate Energy Technology
US Dept. of Energy-Region II
26 Federal Plaza
New York, NY 10007

Bureau of Land Management
Washington, DC 20240

Bureau of Mines
US Department of the Interior
Cochrans Mill Rd.
PO Box 18070
Pittsburgh, PA 15236.

Soil Conservation Service
U.S. Department of Agriculure
PO Box 2890
Washington, DC 20013

U.S. Fish and Wildlife Service
18th and C Streets NW
Washington, DC 20240

U.S. Forest Service
PO Box 2417
Washington, DC 20013

U.S. Environmental Protection Agency
Office of Solid Waste
Management Programs
401 M St., SW
Washington, DC 20460
(202) 382-4627

U.S. Environmental Protection Agency Region I
State Waste Program Branch,
Room 1903
J. F. Kennedy Federal Building
Boston, MA 02203
(617) 835-3698

U.S. Consumer Product Safety Commission
Washington, DC 20207
(800) 638-2772
Northeastern Regional Office
6 World Trade Center, 3rd Floor
Vesey Street, NY 10048
(212) 264-1125

An independent regulatory agency charged with reducing unreasonable risks of injury associated with consumer products. Headed by five commissioners appointed by the President with the advice and consent of the senate.

Programs: National Poison Prevention Week

Publications: Editor's Fact Sheet - 1989; List of Materials - 1989 over 60 brochures, posters, audio-visuals and other poison prevention materials available from various organizations.

Association of State and Territorial Solid Waste ManagementOfficials
444 North Capitol Street, N.W.
Washington, DC 20001
(202) 624-5828

New England Waste Management Officials Association
85 Merrimac Street
Boston, MA 02114
(617) 367-8558

Northeast Recycling Council
270 Broadway
New York, NY 10017
(212) 693-0400
Contact: Shelley Dresser-Gagnon

Formed in Sept. 1987 by northeastern state recycling officials to exchange information, encourage recycling between states and take positions on waste reduction, reuse and recycling.

Coalition of Northeastern Governors
Hall of States
400 North Capitol Street
Suite 382
Washington, DC
Contact: Anne Stubbs

Midwest Recycling Coalition
P.O. Box 90729
Lincoln, NE 68501
(402) 475-3637

B.3.1 STATE RECYCLING CONTACTS

ALASKA

Alaska Recyclers Association
5650 Camelot Drive
Anchorage, AK 99508

Alaskans for Litter Prevention and Recycling
P.O. Box 231231
Anchorage, AK 99523
(907) 272-9326

ARIZONA

Mark Ginsberg, Energy Director
Arizona Energy Office
Department of Commerce
1700 W. Washington Street
Phoenix, AZ 85007
(602) 255-3632

ARKANSAS

Mark Witherspoon
Assistant Chief
Solid Waste Management Division
Department of Pollution Control & Ecology
8001 National Drive
P.O. Box 9583
Little Rock, AR 72219
(501) 562-7444

CALIFORNIA

Carole Brow
Waste Management Board
1020 9th Street, Suite 300
Sacramento, CA 95814
(916) 322-3330

Susan Eddy, Manager
Local Government Assistance Center
Division of Recycling
Department of Conservation
819 19th Street
Sacramento, CA 95814

Rick Anthony
California Resource Recovery Association
13223 Black Mountain Road
Box 1-300
San Diego, CA 92129
(619) 694-2161

COLORADO

Glenn Mallory
Industrial Hygienist
Hazardous Materials and Solid Waste Division
Department of Health
4210 East 11th Avenue
Denver, CO 80220
(303) 331-4830

CONNECTICUT

Lois Hagar
Source Separation Consultant
Local Assistance and Program Coordination Unit
Department of Environmental Protection
State Office Building
Hartford, CT 06106
(203) 566-5847

DELAWARE

Richard Folmsbee, Supervisor
Solid Waste Management Branch
Department of Natural Resources and Environmental Control
89 King's Highway
P.O. Box 1401
Dover, DE 19903
(302) 736-3820

FLORIDA

Margaret Elligett
Recycling Coordinator
Department of Environmental Regulations
2600 Blair Stone Road
Tallahassee, FL 32301
(904) 488-0300

GEORGIA

Jim Dunbar, Program Manager
Environmental Protection Division
Municipal Solid Waste Control
Department of Natural Resources
3420 Norman Berry Rd.
Hapeville, GA 30354
(604) 656-2836

HAWAII

Albert Dung
Environmental Engineer
Department of Health
P.O. Box 3378
Honolulu, HI 96801
(808) 548-6410

IDAHO

Jerome Jonkawski
Solid Waste Management Specialist
Division of Environmental Quality
Department of Health and Welfare
450 West State Street - 3rd Floor
Boise, ID 83720
(208) 334-5879

Idaho Sanitary Service Institute
c/o Mr. Joe Johnson
P.O. Box 8036
Mosion, ID 83843
(208) 882-5724

ILLINOIS

Dave Buckner, Director
Office of Solid Waste and Renewable Resources
Illinois Department of Energy and Natural Resources
325 West Adams Street
Springfield, IL 62704
(217) 524-5454

Illinois Association of Recycling Centers
P.O. Box 2603
Naperville, IL 60565
(217) 351-4584

INDIANA

Mary Swindler, Resource Recovery Coordinator
Department of Environmental Management
105 South Meridian
Indianapolis, IN 46225
(317) 232-8883

B.3.2 STATE RECYCLING CONTACTS

IOWA

Teresa Hay, Administrator
Waste Management Authority Division
Iowa Department of Natural Resources
900 E. Grand Avenue
Des Moines, IA 50319
(515) 281-8975

Ron Mace
Society of Solid Waste Operations
Route 1 Box 16
Fort Madison, IA 52627
(312) 372-6140

KANSAS

J. E. Cronin
Environmental Engineer
Department of Health and Environment
Forbes Field
Topeka, KS 66620-0001
(913) 296-1590

KENTUCKY

Charles F. Peter, Manager
Resources Management Branch
Division of Waste Management
18 Reilly Road
Frankfort, KY 40601
(502) 564-6716

LOUISIANA

Victor Tompkins
Louisiana Resource Recovery and Development Authority
P.O. Box 44066
Baton Rouge, LA 70804
(504) 342-4593

MAINE

Clif Eliason
Recycling Coordinator
Department of Environmental Protection
Station #17/State House
Augusta, ME 04333
(207) 289-2111

Ed Stritzky
Maine Solid Waste Management and Recovery Association
Local Government Center
RFD 4 Box 35
Augusta, ME 04330
(207) 623-8428

MARYLAND

Kendra Bonderud, Planner
Maryland Environmental Service
60 West Street
Annapolis, MD 21401
(301) 269-3355

Richard Keller
Maryland Energy Office
45 Calvert Street
Annapolis, MD 21401-1907

MASSACHUSETTS

Gretchen Brewer, Recycling Program Manager
Division of Solid Waste Management
1 Winter Street
Boston, MA 02108

MICHIGAN

Fred Clinton, Chief
Resource Recovery Section
Waste Management Division
Department of Natural Resources
P.O. Box 30028
Lansing, MI 48909
(517) 373-0540

Pamela Baynes
Michigan Recycling Coalition
P.O. Box 10240
Lansing, MI 48901

Waste Systems Institute
Jeff Dauphin
470 Market Street, SW
Suite 100A
Grand Rapids, MI 49503

MINNESOTA

Dan Krivit
Minnesota Waste Management Board
1350 Energy Lane
St. Paul, MN 55108
(612) 649-5750

Recycling Association of Minnesota
P.O. Box 30632
St. Paul, MN 55175
(612) 646-2591

MISSISSIPPI

Mark Williams
Solid Waste Section Head Coordinator
Bureau of Pollution Control
Department of Natural Resources
P.O. Box 10385
Jackson, MS 39209
(601) 961-5060

MISSOURI

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Solid Waste Planning Unit
Department of Natural Resources
P.O. Box 176
Jefferson City, MO 65102
(314) 751-3176

Jane Bishop
Missouri State Recycling Association
P.O. Box 331
St. Charles, MO 63301

Jim Garvin
Missouri Waste Control Coalition
P.O. Box 1125
Jefferson City, MO 65102

MONTANA

Duane Robertson, Chief
Solid and Hazardous Waste Bureau
Department of Health and Environmental Sciences
Cogswell Building
Helena, MT 59620
(406) 449-2821

Mike Chaffin
Associated Recyclers of Montana
P.O. Box 287
Hamilton, MT 59840

NEBRASKA

Dannie Dearing
Litter Program Specialist
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Litter Reduction and Recycling Programs
Department of Environmental Control
P.O. Box 98922
Lincoln, NE 68509
(402) 471-2186

Dale Gubbels
Nebraska State Recycling Association
Box 80729
Lincoln, NE 68501
(402) 475-3637

NEVADA

Curtis Framel
Energy Programs Manager
Office of Community Services
1100 E. Williams Street
Carson City, NV 89710
(702) 885-4908

NEW HAMPSHIRE

Thomas Sweeney, Administrator
Solid Waste Bureau
Health and Human Services Bldg.
Six Hazen Drive
Concord, NH 03301
(603) 271-2925

Gary Olson
New Hampshire Resource Recovery Association
P.O. Box 721
Concord, NH 03302-0721
(603) 224-6996

NEW JERSEY

Aletha Spang
Acting Administrator
Office of Recycling
Division of Solid Waste Management
Department of Environmental Protection
401 East State Street
CN 414
Trenton, NJ 08625
(609) 292-0331

Trish Ferrand
Association of New Jersey Recyclers
P.O. Box 625
Abescon, NJ 08201
(201) 641-8292

Jean Clark, President
New Jersey Recycling Forum, Inc.
219 North Fullerton Avenue
Montclair, NJ 07042
(201) 783-5600

NEW MEXICO

Phillip Weston
Environmental Improvement Division
P.O. Box 968
Santa Fe, NM 87503
(505) 827-2850

NEW YORK

Robert P. McCarty, Acting Chief
Bureau of Municipal Waste
Division of Source Reduction and Recycling
Department of Environmental Conservation
50 Wolf Road
Albany, NY 12233
(518) 457-7337

David Mafrici
New York State Association for Solid Waste Management
P.O. Box 13461
Albany, NY 12212
(518) 457-3691

NORTH CAROLINA

Paula Byrd
Solid Waste Management Section
Department of Human Resources
P.O. Box 2091
Raleigh, NC 27602
(919) 733-2178

Cassandra Maurer
North Carolina Recycling Association
178 Chatham Road
Asheville, NC 28804

North Carolina Coalition for Renewable Energy Resources
404 Vernon Terrace
Raleigh, NC 27609
(919) 781-4229

NORTH DAKOTA

David J. Switlick
Environmental Scientist
Solid Waste Management Division
Division of Environmental Waste Management
Department of Health
P.O. Box 5520
Bismarck, ND 58502-5520
(701) 224-2366

OHIO

Mary Wiard, Chief
Division of Litter Prevention and Control
Ohio Department of Natural Resources
Fountain Sq., Bldg. E-1
Columbus, OH 43224
(614) 265-6353

Federation of Ohio Recyclers
2801 Far Hills Avenue
Dayton, OH 45419
(513) 294-8080

Paul Braasch
Greater Ohio Recyclers
9620 Mt. Orab Pike
Georgetown, OH 45121
(513) 378-3431

OKLAHOMA

R. Fenton Rood, Director
Resource Recovery Division
Department of Health
1000 N.E. 10th Street
Oklahoma, OK 73152
(405) 271-7169

OREGON

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Department of Environmental Quality
811 S.W. Sixth Avenue
Portland, OR 97204
(503) 229-6975

Kathy Cancilla
Association of Oregon Recyclers
P.O. Box 10051
Portland, OR 97210
(503) 761-8075

PENNSYLVANIA

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Division of Resource Recovery and Planning
Bureau of Solid Waste Management
Department of Environmental Resources
P.O. Box 2063
Harrisburg, PA 17120
(717) 787-7382

Pennsylvania Resources Council
44 East Front Street
Media, PA 19063
(215) 565-9131

Ruth Becker
Pennsylvania Recycling Network
44 E. Front Street
Media, PA 19063
(215) 565-9131

RHODE ISLAND

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Recycling Coordinator
Office of Environmental Coordination
RI Dept. of Environmental Management
9 Hayes Street
Providence, RI 02908-5003

Marion Gold
Recycling Program Manager
Solid Waste Management Corporation
260 West Exchange Center
Providence, RI 02903
(401) 831-4440

SOUTH CAROLINA

Allan E. Raymond
Environmental Engineer
Department of Health and Environmental Control
2600 Bull Street
Columbia, SC 29201
(803) 758-5681

SOUTH DAKOTA

Steve Wegman, Director
Energy Conservation Programs
Office of Energy Policy
State Capital Building
Pierre, SD 57501
(605) 773-3603

TENNESSEE

Frank Victory
Department of Health & Environment
701 Broadway
Nashville, TN 37219
(615) 741-3424

Tennessee Valley Association of Recyclers
c/o Ms. Joann Christopher
Route 5, Box 318
Athens, Alabama 35611

TEXAS

Glendon Eppler
Division of Solid Waste Management
Department of Health
1100 West 49th Street
Austin, TX 78756-3199
(512) 448-7271

Kay Knapp, Executive Director
Texas Recyclers Association
8609 Cross Park Drive
Austin, TX 78754
(512) 339-8566

UTAH

Brent C. Bradford, Director
Solid & Hazardous Waste
Department of Environmental Health
288 N. 1460 West
Salt Lake City, UT 84110
(801) 538-6170

VERMONT

Recycling and Resource Conservation Section
Solid Waste Division
103 South Main St.
Waterbury, VT 05676
(802) 244-7831

Glenn McRae, Director
Association of Vermont Recyclers
P.O. Box 1244
Montpelier, VT 05601
(802) 229-1833

VIRGINIA

Walter Gust
Communications Director
Division of Litter Control and Recycling
Department of Waste Management
1215 Washington Building
Richmond, VA 23219
(804) 786-8679

R. Allen Lassiter, Jr.
Transportation Engineer
Division of Energy
Department of Mines, Minerals and Energy
2201 West Broad Street
Richmond, VA 23220
(804) 367-13100

WASHINGTON

Recycling Information Office
Department of Ecology
Mail Stop PV11
Olympia, WA 98504
(206) 459-6000

Washington State Recycling Association
P.O. Box 569
Seattle, WA 98111
(206) 773-0830

WEST VIRGINIA

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Department of Natural Resources
Solid Waste Section
1260 Greenbriar Street
Charleston, WV 25311
(304) 348-5993

WISCONSIN

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Bureau of Solid and Hazardous Waste Management
Department of Natural Resources
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Madison, WI 53707
(608) 267-7565

Associated Recyclers of Wisconsin
Sherri Frederick, Secretary
1900 Westmore Terrace
Elm Grove, WI 53122
(414) 871-0860

WYOMING

David A. Finley
Program Manager
Solid Waste Management
Dept. of Environmental Quality
122 West 25th Street
Cheyenne, WY 82002
(307) 777-7752

THE ALUMINUM ASSOCIATION
900 19th Street, N.W.
Washington, DC 20006
(202) 862-5163
Frank H. Rathbun, Manager, Public Information and Packaging Programs

Publications (Single copies of the following general publications are free; contact the Aluminum Association for a full publications list):
Fact Sheets (including Aluminum Recycling, Aluminum Food and Beverage Cans, Aluminum Foil and Packaging.)
The Advantages Stack Up-the All Aluminum Beverage Can, 1987.
Energy Conservation and the Aluminum Industry, 1985.
Aluminum and the Environment, 1980.

Audio-Visuals: *Aluminum Recycling: Your Next Assignment* (videotape).
Explains environmental and fund-raising benefits of aluminum can recycling, as well as the aluminum process--from the making of the metallic aluminum through the actual recycling process. To be released Fall 1988.

ALUMINUM CO. OF AMERICA
Voluntary Reclamation Program Mgr.
1501 Alcoa Bldg.
Pittsburgh, PA 15219

ALUMINUM RECYCLING ASSOCIATION
1000 16th Street, N.W.
Suite 603
Washington, DC 20036
(202) 785-0951
Mr. Richard M. Cooperman

Publications: *Serving the World's Demand For Materials.* Pamphlet on aluminum recycling process.

AMERICAN IRON AND STEEL INSTITUTE
1000 16th Street, NW
Washington, DC 20036
(202) 452-7100

AMERICAN PAPER INSTITUTE
Paper Recycling Committee
260 Madison Avenue
New York, NY 10016
(212) 340-0600
J. Rodney Edwards

Publications: Free paper recycling pamphlets and brochures including: 12 Facts About Waste Paper Recycling, How to Recycle Waste Paper, and Paper Recycling and It's Role In Solid Waste Management. Posters: How Paper Came To America and The Recycling Cycle. Audiovisuals: Free loan of a videotape on paper recycling.

AMERICAN RETREADERS ASSOCIATION
P.O. Box 17203
Louisville, KY 40217
(502) 367-9133

ANHEUSER-BUSCH COMPANIES, INC.
Government and External Affairs
Executive Offices
One Busch Place
St. Louis, MO 63118-1852
(Container Recovery Corporation)

Publications: Winning the Fight Against Litter (brochure describing existing recycling and litter management programs across the U.S.); *Journal of Resource Management and Technology,* Vol. 14, No. 2, October 1985 (Deals specifically with litter reduction and recycling nationwide).

ASSOCIATION OF PETROLEUM RE-REFINERS
P.O. Box 427
Buffalo, NY 14205
(716) 855-2212

AMERICAN PETROLEUM INSTITUTE
2101 L Street NW
Washington, DC 20037

Publications: *Recycle Used Motor Oil: A Model Program.*

AUTOMOTIVE DISMANTLERS & RECYCLERS EDUCATION FOUNDATION
1133 15th Street NW
Washington, DC 20005
(202) 293-2372

CAN MANUFACTURERS INSTITUTE, INC.
1625 Massachusetts Avenue NW
Washington, DC 20036
(202) 232-4677

Publications: *The Can: Yesterday Today & Tomorrow.*

CENTER FOR PLASTICS RECYCLING RESEARCH
Building 3529, Busch Campus
Rutgers University
Piscataway, NJ 08855
(201) 932-4402

CHEMICAL MANUFACTURERS ASSOCIATION
2501 M Street, NW
Washington, DC 20037
202-887-1204

Publications: "Chemocology" a publication covering health, safety and the environment.

COPPER AND BRASS FABRICATORS COUNCIL
Suite 440
1050 17th Street NW
Washington, DC 20036
(202) 833-8575

COUNCIL ON PLASTICS PACKAGING IN THE ENVIRONMENT
1275 K Street
Washington, DC 20005
(202) 371-5228

FIBRE BOX ASSOCIATION
8725 W. Higgins Road
Chicago, IL 60631
(312) 693-9600

GLASS PACKAGING INSTITUTE
1133 20th Street, NW, Suite 321
Washington, DC 20036
(202) 887-4850

Publications: *Glass Recycling: Why? How?* (Discusses glass recycling and lists glass container collection and recycling centers.); Forced Deposits: The Hidden Costs, (Discussion of Forced Deposit Laws and their alternatives--litter reduction and recycling laws.); *The Great Glass Caper*
(Teaching kit designed to teach about benefits of recycling glass containers, newspapers and aluminum cans. Includes teacher's guide, copycat pages, color poster and minifilmstrip. Upper elementary.)

Audio/visuals: *Recycling: The Need Is Clear.* (12 mins. Highlights glass recycling programs nationwide.)

INSTITUTE OF SCRAP RECYCLING INDUSTRIES, INC.
1627 K Street, NW
Washington, DC 20006
(202) 466-4050

1987 merger of the Institute of Scrap Iron and Steel, Inc. and the National Association of Recycling Industries, Inc. Membership consists of processors, brokers, consumers of scrap (ferrous and nonferrous metals, paper, plastics, and textiles), and suppliers of equipment and services to the industry.

Publications: *Phoenix Quarterly.* Complimentary copies available. Reprints available including "Tin Can Recycling," Spring 1977; "Municipal Waste," Winter 1980, and "Materials Recovery from Municipal Waste." Careers and Job Opportunities in the Scrap Industries - eight page tabloid newspaper available in classroom quantities without charge. Mines Above Ground - general information folder available in classroom quantities without charge. *Metallic Scrap: The Manufactured Resource.* Single copies free.

KEEP AMERICA BEAUTIFUL
Mill River Plaza
9 West Broad Street
Stamford, CT 06902
(203) 323-8987

A national nonprofit organization funded primarily by the beverage industry to promote voluntary recycling and anti-litter campaigns; opposed to deposit legislation.

Waste In Place: An interdisciplinary sequential curriculum for K-6. $40. Many fact sheets and publications, primarily pertaining to the KAB System approach to litter control and recycling. Contact KAB for free price list.

NATIONAL ASSOCIATION OF RECYCLING INDUSTRIES
330 Madison Avenue
New York, NY 10017
(212) 867-7330

NATIONAL ASSOCIATION FOR PLASTIC CONTAINER RECOVERY
P.O. Box 7784
Charlotte, NC 28241
(704) 523-8543

NATIONAL ASSOCIATION OF WIPING CLOTH MANUFACTURING
P.O. Box 17086
Washington, DC 20041
(703) 661-6377

NATIONAL CENTER FOR RESOURCE RECOVERY, INC.
1211 Connecticut Avenue, N.W.
Washington, DC 20036
Contact: Director of Information Programs.

Publications: *Waste Not.* (A Primer on Resource Recovery) $.15; Glossary (Definitions of waste management and resource recovery subjects) $.50; Fact Sheets (Set of 16 fact sheets on various solid waste management and resource recovery subjects) $1.50; *NCRR Bulletin* (A quarterly journal for both the technician and the layman) $5/yr; *NCRR Bulletin Reprints* (Municipal Solid Waste..Its Volume, Composition and Value, Municipal Solid Waste...A Source of Energy, Resource Recovery...A Status Report. $.50 each.).

Audio-visuals: *Things Worth Saving.* 13:50 minutes, 16 mm color film, $75; "Waste Not" Slide Presentation (60 slides) $55.

NATIONAL SOFT DRINK ASSOCIATION
1101 Sixteenth Street, NW
Washington, DC 20036
(202) 463-6732

NATIONAL SOLID WASTES MANAGEMENT ASSOCIATION
1730 Rhode Island Ave., NW,
Suite 1000
Washington, DC 20036
(202) 659-4613

Publications: Several colorful pamphlets and fact sheets on various solid waste topics.

Audio/visuals: "The Great Disappearing Act: Waste Services Today" slide and sound show about the waste services industry. $125 purchase for non-members, $65 for members.

PAPERBOARD PACKAGING COUNCIL
1101 Vermont Avenue NW
Suite 411
Washington, DC 20005
(202) 289-4100

PLASTICS RECYCLING FOUNDATION
1275 K Street, N.W., Suite 400
Washington, DC 20005

PLASTICS RECYCLING APPLIED RESEARCH INSTITUTE "PRARI"
North Billerca, MA

Recycles mixed plastic waste into plastic lumber substitute; a research project funded jointly by CRInc., University of Lowell, and State of Massachusetts.

REYNOLDS ALUMINUM RECYCLING CO.
117 Murphy Rd.
Hartford, CT 06114
(203) 278-6136

Publications: *Michael Recycle* (free comic book on can recycling); How Aluminum is Recycled by Reynolds (Color Your Own Recycling Poster).

RUBBER MANUFACTURERS ASSOCIATION
1400 K St. NW
Washington, DC 20005
(202) 682-1338

SOCIETY OF THE PLASTICS INDUSTRY, INC.
1275 K Street, NW, Suite 400
Washington, DC 20005
(202) 371-5200

Publications: "The Plastic Bottle Reporter"

Audio-visuals: "Plastics Recycling: A Strategic Vision," (video) 8 mins. Describes Rutgers Pilot Recycling Program and illustrates the plastics recycling process.

TECHNICAL ASSOCIATION OF PULP AND PAPER INDUSTRIES
P.O. Box 105113
Atlanta, GA 30348
(404) 446-1400

TEXTILE FIBERS & BY-PRODUCTS ASSOCIATION
P.O. Box 11065
Charlotte, NC 28220
(704) 527-5593

TIRE RETREAD INFORMATION BUREAU
26555 Carmel Rancho Blvd.
Suite 3
Carmel, CA 93923
(408) 625-3247

THE CHILDREN'S MUSEUM
300 Congress St.
Boston, MA 02210
(617) 426-6500

Focus: Education.

Resources:
Kit Rental (Ext. 231)
Many different curriculum, discovery and exhibits kits (including papermaking). Rental fees start at $15.
"Recycle" Center (Ext. 210)
Clean industrial scrap for sale to general public. Great resources for classroom projects.

CENTER FOR MARINE CONSERVATION
1725 DeSales St. N.W. Suite 500
Washington, DC 20036
(202) 429-5609

Focus: Education, direct action (beach clean up, etc.).

Publications:
Citizen's Guide to Plastics in the Ocean, More than a Litter Problem; Plastic Recycling and Degradable Information Packet (free). Write for complete listing of information packets.

CENTER FOR SAFETY IN THE ARTS
5 Beekman Street, Suite 1030
New York, NY 10038
(212) 227-6220

Focus: Education. Maintains an information clearinghouse on toxicity in art supplies.

Publications:
Many books and fact sheets including *Art Hazards*, 4 page newsletter; Micheal McCann, *Artists Beware: The Hazards and Precautions in Working with Art and Craft Materials*, 1979, ($18.95); *Children's Art Supplies Can Be Toxic*, 8 page fact sheet, ($2.00). Contact for complete publication list.

CENTER FOR THE BIOLOGY OF NATURAL SYSTEMS
Queens College
Flushing, NY 11367
(718) 670-4182

Focus: Research and legislative involvement on many environmental issues.

Publications:
Research reports on hazards associated with mass-burn incineration and information on Intensive Recycling Systems in East Hampton and Buffalo, NY.

CITIZEN'S CLEARINGHOUSE FOR HAZARDOUS WASTE
P.O. Box 926
Arlington, VA 22216
(703) 276-7070

Focus: Grassroots organizing, public awareness, legislative involvement.

Publications:
Household Hazardous Waste Fact Pack ($2.00); *Recycling--The Answer to Our Garbage Problems* ($8.98).

COALITION FOR RECYCLABLE WASTE
c/o Environmental Action
1525 New Hampshire Ave., NW
Washington, DC 20036
(202) 745-4879

Focus: Grassroots organizing, consumer education. Campaigns directly with industry promoting use of recyclable material.

Publications:
Recyclability, membership newsletter.

THE ENTANGLEMENT NETWORK
c/o Defenders of Wildlife
1244 Nineteenth St., NW
Washington, DC 20036

Focus: Coalition of 22 national organizations working on plastic litter and its effects on marine animals.

ENVIRONMENTAL ACTION COALITION
625 Broadway (Bleeker/ Houston)
New York, NY 10012
(212) 677-1601

Focus: Multi-issue environmental organization, education, legislative involvement.

Publications:
Eco-News (newsletter for grades 4-6) and *Cycles* (adult newsletter), reprint of solid waste related articles available; *Don't Waste Waste*, curriculum guide ($3.50).

ENVIRONMENTAL ACTION FOUNDATION
1525 New Hampshire Ave, NW
Washington, DC 20036
(202) 745-4879

Focus: Legislative involvement, clearinghouse on waste reduction legislation, technical assistance in implementing recycling programs.

Publications:
Environmental Action Magazine, quarterly membership publication covering environmental issues including solid and hazardous waste ($20.00); *Wastelines*, quarterly newsletter focusing on solid waste and recycling; *Bottle Bills in the 80's: A Handbook for Effective Citizen's Action* ($5.00); *Organizer's Manual*; Jeanne Wirka, *Wrapped in Plastics: The Environmental Case for Reducing Plastics Packaging*, August 1988 ($10.00).

ENVIRONMENTAL DEFENSE FUND
444 Park Avenue South
New York, NY 10016
(212) 686-4191

Capital Office
1616 P St. NW
Washington, DC 20036

Focus: Legislative involvement in many environmental issues; national recycling campaign sponsor.

Publications:
Coming Full Circle: Successful Recycling Today ($12.00 from NY Office); *Incineration and Recycling: A Basis for Comparison* ($10.00 from Capital Office).

ENVIRONMENTAL RESEARCH FOUNDATION
P.O. Box 3541
Princeton, NJ 08543

Focus: Research and education on many environmental issues.

Publications:
Rachel's Hazardous Waste News, weekly newsletter for citizens fighting toxic pollution, ($25/yr for individual, $6/yr for student/senior citizens).

GREENPEACE
1436 U Street, NW
Washington, DC 20009
(202) 462-1177

Regional Office:
Greenpeace Northeast
139 Cambridge, MA 02142
(617) 983-0300

Focus: Multi-issue organization (toxics, marine animal protection, nuclear issues) using direct action as means for public awareness. Also involved with legislative initiatives.

Publications:
Greenpeace, monthly membership newsletter; *Waste Management, Inc.: The Greenpeace Report*; *Burnt Offerings* (about shipment of toxic incinerator ash from Philadelphia to Panama).

INFORM
381 Park Avenue South
New York, NY 10016
(212) 689-4040

Focus: Research and education. Identifies and reports on practical action for protection and conservation of natural resources and public health.

Publications:
Joanna Underwood, Allen H. and Maarten deKadt, *Garbage: Practices, Problems and Remedies*, 1988, ($3.50); Allen Hershkowitz, Ph.D. and Eugene Salerni, *Garbage Management in Japan: Leading the Way*, 1987, ($15.00); Allen Hershkowitz, Ph.D., Garbage Burning, Lessons From Europe, 1986, ($9.95).

INSTITUTE FOR LOCAL SELF-RELIANCE
1717 18th Street NW
Washington, DC 20009
(202) 232-4108

Focus: Community consultants for solid waste and economic development.

Publications:
Waste to Wealth: A Business Guide For Community Recycling Enterprises ($37.00).

LEAGUE OF WOMEN VOTERS
1730 M Street, NW
Washington, DC 20036
(202) 429-1965

Focus: Multi-issue group, legislative and public awareness orientation.

Publications:
A Hazardous Waste Primer, 1980. 8 pages, #402 ($.75, ISBN 252-X); *Is There Enough Trash For Everybody?* 1978, 4 pages, #255 ($.65, ISBN 172-8), discusses the compatibility of source separation, resource recovery and waste reduction; *Curbing Trash*, 1977, 6 pages, #147 ($.85, ISBN 17 3-6).

NATIONAL AUDUBON SOCIETY
950 Third Avenue
New York, NY 10022
(212) 832-3200

Focus: Multi-issue organization (primarily wildlife issues), education oriented.

Publications:
Audubon, bimonthly membership publication; *Audubon Adventures*, environmental education publication.

NATIONAL CENTER FOR APPROPRIATE TECHNOLOGY
3040 Continental Drive
P.O. Box 3838
Butte, MT 59702

Focus: Multi-issue research organization.

Publications:
Connections: A Curriculum In Appropiate Technology for 5th and 6th grades; several wastewater treatment and composting papers. Contact for complete list.

NATIONAL RECYCLING COALITION
Suite 304
1101 30th Street NW
Washington, DC 20007
(202) 625-6406

Focus: Coalition of recycling industries and groups which sponsors an annual confe and acts as a policy an mation center.

NATIONAL TOXICS CAMPAIGN
29 Temple Place, 5th Floor
Boston, MA 02111
(617) 482-1477

Focus: Developing and implementing solutions to toxic crises.

Publications:
Adams Mitchell, *Once Is Not Enough: A Citizen's Recycling Campaign*, 1988; Publication list and summary of activities available upon request.

NATIONAL WILDLIFE FEDERATION
1412 16th St. NW
Washington, DC 20036
(202) 797-6800

Focus: Multi-issue environmental organization, primarily education oriented. Some legislative involvement.

Publications:
Membership magazines, *National Wildlife* (bimonthly) and *International Wildlife* (alternate months); *Ranger Rick Magazine* (grades 4-6, monthly); *Nature Scope* (quarterly teacher's magazine. Each issue focuses on one topic and includes activity ideas and background information.); "Recycle for the Birds" (Reprint on making bird feeders from trash).

NATURAL RESOURCE DEFENSE COUNCIL
40 W. 20th Street
New York, NY 10011
(212) 727-2700

Focus: Research and legislative involvement on many environmental issues.

Publications:
Amicus Journal, quarterly membership publication; additional information on solid waste legislation in New York state. *A Solid Waste Blueprint for New York State*, 1988 ($10.00).

THE NEW ALCHEMY INSTITUTE
237 Hatchville Road
East Falmouth, MA 02536
(508) 564-6301

Focus: Research and education on alternative food production and composting.

Publications:
Bruce Fulford, *Research Report on A Composting Greenhouse*, 1987; Tad Montgomery, *Home-scale Waste Water Treatment.*

PENNSYLVANIA RESOURCES COUNCIL
44 East Front Street
Media, PA 19063
(215) 565-9131

Focus: Recycling and litter control. Organized an environmental shopping campaign.

RADIOACTIVE WASTE CAMPAIGN
625 Broadway 2nd Floor
New York, NY 10012
(212) 473-7390

Focus: Promotes public awareness of the dangers to human health and the biosphere from the generation of radioactive waste. Programs include research and public eduction.

Publication:
RWC Waste Report, quarterly newsletter ($8.00/yr).

RESOURCES FOR THE FUTURE
1616 P Street
Washington, DC 20036
(202) 328-5000

Focus: Research oriented, dealing with a wide range of environmental issues focusing on energy, forest and soil conservation.

Publications:
Resources, quarterly magazine; Report on managing ash from municipal solid waste incinerators ($15.00).

WORK ON WASTE USA, INC.
82 Judson Street
Canton, NY 13617
(315) 379-9200

Focus: Public awareness on a variety of solid waste issues.

Publications:
Waste Not, weekly newsletter, ($35.00/yr).

Audio/visuals:
Extensive collection of videos produced in conjunction with Video-Active Productions, documenting recycling programs and incineration issues. See listing in Resources Section C.3.a. or write for a current list.

WORLDWATCH INSTITUTE
1776 Massachusetts Avenue
Washington, DC 20036
(202) 452-1999

Focus: Natural resources and global environmental issues.

Publications:
William Chandler, *Paper #56: Materials Recycling: The Virtue of Necessity*, 1984, ($4.00); Cynthia Pollack, *Paper #76: Mining Urban Wastes: The Potential for Recycling*, 1987, ($4.00); *Worldwatch*, membership quarterly ($20.00/yr).

BIO-PAX
1265 Pine Hill Drive
Annapolis, MD 21401
(301) 974-4411

"Packaging and Office Products For A Safe Environment."

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10 Lombard Street
San Francisco, CA 94111
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Contact: Carla Maloney

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Griswold Industrial Park
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(802) 862-4289
Contact: Bill Dunn

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Contact: Ed Berns

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Boston, MA 02135
(617) 277-9901
Contact: Ted Vansant

Copy paper, envelopes, fine paper.

RECYCLED PAPER OUTLET
P.O. Box 10540
Portland, OR 97210
(503) 227-1319

DANIEL O. REICH, INC.
7518 Third Avenue
Brooklyn, NH 11209-3198
(718) 748-6000
Contact: Ray Darmstadt

RIS PAPER CO., INC.
P.O. Box 492
Concord, NH 03301
(800) 258-3692
Contact: George Taylor

SAVE OUR ECOSYSTEMS
541 Williamette Street
Room 102
Eugene, OR 97401
(503) 484-2679

VERMONT IMPORTANT PAPER
Box 90
Cuttingsville, VT 05738
(802) 492-3304
Contacts: Lily and Eldrid French

RESOURCES B.7 SOURCES OF RECYCLING CONTAINERS

For a full listing of recycling collection and processing equipment, see the State of Vermont's *Directory of Recycling Collection and Processing Equipment.*

ADVANCED RECYCLING SYSTEMS, INC.
PO Box 1796
Waterloo, IA 50704
Contact: Bob Armstrong
(310) 291-6007

Distributor:
Metropolitan Waste Equipment
Boston, MA
Contact: Gil Ledoux
(617) 344-8262

Residential recycling kits.

THE BAG CONNECTION
P.O. Box 817
Newburg, OR 97132
Contact: Doug Bunn
(800) 62B-AGIT

Recycling bags.

BUCKHORN MHP, INC.
2775 Slough Street
Mississauga, ON L4T IG2
Canada
Contact: Ray Gargarella
(416) 678-6545

Distributor:
David Gherlone
100 Stevenson Road
New Haven, CT 06515
(203) 389-1151

Curbside recycling containers.

BUSCH-COSKERY OF CANADA, INC.
1502 Greywood Road
Mississauga, ON L5H 2T4
Canada
Contact: Craig W.W. Busch
(416) 274-9619

Curbside collectors, household recycling containers.

DYE PLASTICS, INC.
3000 Lind Avenue, S.W.
Renton, WA 98055
Contact: Clayton Leady
(800) 543-5267

Household recycling containers.

REHRIG PACIFIC CO.
4010 East 26th Street
Los Angeles, CA 90023
Contact: Vince Saia
(213) 262-5145

Distributor:
Jack Weber
Raymond Industrial Park
Raymond, NH 03077
(603) 895-4743

Plastic curbside collection containers.

SHAMROCK INDUSTRIES, INC.
834 North 7th Street
Minneapolis, MN 55411-4394
Contact: Mark Smiler
(800) 822-2342

Curbside recycling containers.

WHITE RIVER PAPER COMPANY
P.O. Box 455
White River Junction, VT 05001
Contact: Joe Couture
(802) 295-3188
(800) 622-4113

Desk-top containers, toters and stackable bins.
(Diversified Recycling Systems, Rehrig Pacific, Rubbermaid)

(ANR) indicates that old issues may be available at the Vermont Agency of Natural Resources, Department of Environmental Conservation, Solid Waste Division (244-7831). (AVR) indicates that old issues may be available at the Association of Vermont Recyclers, 64 Main St., Montpelier (229-1833).

Beverage World (ANR)
World Headquarters
150 Great Neck Road
Great Neck, NY 11021
$30/yr (12 issues)
Focus: beverage container recycling.

BioCycle: The Journal of Waste Recycling (ANR, AVR)
33 East Minor Street
P.O. Box 351
Emmaus, PA 18049
$46/yr (10 issues)
Focus: composting.

Conservation and Recycling: The Management of World Wastes
Communications Channels, Inc.
6255 Barfield Road
Atlanta, GA 30328
$29/yr

Garbage (AVR)
P.O. Box 51647
Boulder, CO 80321-1647
$21/yr (6 issues)
Focus: consumer education.

Plastic Recycling Update
P.O. Box 10540
Portland, OR 97210
$85/yr (12 issues)
Focus: plastics recycling.

Recycling Times
Suite 1000
1730 Rhode Island Ave., NW
Washington, DC 20036
$95/yr (26 issues)
Focus: recycling markets.

Recycling Today (AVR)
Gie Inc.
4012 Bridge Avenue
Cleveland, OH 44113
$22/yr (12 issues)

Resource Recovery Report (ANR, AVR)
5313 38th St., NW
Washington, DC 20015
$147/yr (12 issues)

Resource Recycling: North America's Recycling Journal (ANR, AVR)
Resource Recycling Inc.
P.O. Box 10541
1206 NW 21st Street
Portland, OR 97210
$47/yr (11 issues)

Waste Age (ANR, AVR)
Suite 1000
1730 Rhode Island Ave., NW
Washington, DC 20036
$40/yr (12 issues)

SOLID WASTE AND RECYCLING

*(Materials followed with an * have been reviewed in the course of preparing this Guide and are recommended.)*

Audio Visual Aids On Recycling. Bureau of Solid Waste Management, Department of Natural Resources, Box 7921, Madison, WI 53707, October 1985.

A Way With Waste. Washington State Dept. of Ecology, 4350-150th Ave. NE, Redmond, WA 98052 Contact: Jan Lingenfelter (206) 885-1900. Over 80 K-12 activities. Approximately $12. *

Cans For Education Curriculum Guide. New Hampshire Governor's Energy Office, 2 1/2 Beacon St. Concord, NH 03301 ("An innovative learning tool which educates students about the environmental and economic value of recycling. Uses an aluminum cans recycling project as the basis for students to learn about recycling and earn revenue for school related programs. Includes curricula for each classroom subject, Grades 1-6) To order, send name and address, along with an envelope that will hold a 9" x 12" folder with $1.10 postage (3rd class) to NHRRA/ Cans for Education/P.O. Box 721/Concord, NH/03302-0721.

The Case Study Case: Case Studies in Solid Waste. Minnesota Environmental Sciences Foundation, Minneapolis, MN. A Curriculum Activities Guide to Solid Waste and Environmental Studies. The Institute for Environmental Education, Cleveland, OH.

Directory of Resources: An Educator's Guide to Solid Waste Management Education. Mary Kohrell, Midwest Recycling Coalition, Lincoln, NE: 1987.

Divide and Conquer. A Teacher's Guide to Waste Management Grades 4-6. Ontario Ministry of the Environment.

Do It Yourself Guide to: A Solid Waste Seminar. Minnesota Regional Environmental Council. Rochester, MN: Quarry Hill Nature Center, 1977.

Don't Waste Waste! Available from Environmental Action Coalition, 625 Broadway (Bleeker/ Houston), New York, NY 10012 for $3.50.

Educational Programs in Resource Recovery: K-12, Michigan Department of Natural Resources, Lansing, MI.

Garbage Reincarnation: Interdisciplinary Approach to Materials Conservation and Recycling. (4-6) Available for $5.95 from Sonoma County Community Recycling, PO Box 1375, Santa Rosa, CA 95402

The Great Garbage Machine. Toronto, Ontario: Waste Management Advisory Board.

The Great Glass Caper (educational kit on recycling with mini-film strip, poster and mimeograph activity pages and teacher's guide) (4-6) Available free from: Pennsylvania Glass Recycling Corporation, 509 North Second Street Harrisburg, PA 17101 (717) 234-8091 *

Here Today, Here Tomorrow. Brown Mills, NJ: NJ Department of Energy and Environmental Protection. Conservation and Environmental Studies Center, Inc., 1984. Grades K-12

The Importance of Being a Garbologist. Group for Recycling in Pennsylvania. Box 4806, Pittsburgh, PA 15206 Grades 3-6 *

Kansas City Recycling Teacher's Edition. Contact: Sandra Leigh Custard. KC Dept. of Public Works, Mid America Regional Council, 20 W 9th, 7th floor, Kansas City, MO 64105 (816) 474-4240.

Let's Recycle: Lesson Suggestions for Teachers K-6 and 7-12. Washington, DC: US EPA, 1980. Office of Water and Waste Management, Washington, DC 20460, Publication # SW-801. *

Looking Good In Ohio's Schools. Educator's Guides. Grades K-3, 4-6, 7-12, Fountain Square, Columbus, OH: Ohio Dept. of Natural Resources, 1982.

Ohio Science Workbook: Litter Prevention & Recycling. Columbus, OH: Ohio Academy of Science, 1987. Advanced science project ideas, good bibliography.

Operation Waste Watch. Seven Sequential Learning Units. Richmond, VA: Virginia Division of Litter Control, 1980. (K-6) Available only to Virginia residents.

Oscar's Options. Rhode Island: RI Department of Environmental Management, 1986, 1987. Two volumes, $50 each. Grades 4-8. Contact: Carole Bell, RI DEM, 9 Hayes Street, Providence RI 02908. *

Recycling: A Solution To Pollution. Champaign, IL: Community Recycling Center, 1984. Grades K-4. Available for $5 from Lisa Raddke, Community Recycling Center, 720 N. Market, Champaign, Il.

Recycling: Activities for the Classroom. Mary Lynne Bowman and Herbert L. Coon. ERIC/ SMEAC Center, 1200 Chambers Rd., 3rd Floor, Ohio State University, Columbus, OH 43212.

SOLID WASTE AND RECYCLING

Recycling Study Guide. 1988. Available from John Reindl, Wisconsin Dept. of Natural Resources, Madison, WI. Grades 4-12. Good ideas, simple and short. *

Recyculum. Eco-Alliance, 1980. Available from Resource Conservation Consultants, Portland, OR. K-6.

Reduce, Reuse, Recycle: Handbook for School-Wide Recycling Projects. Available from the Arizona Energy Office, State Capitol, 5th Floor, 1700 West Washington, Phoenix, AZ 85007.

Reduction, Reuse, Recycling. Association of Oregon Recyclers, 1615 NW 23rd Avenue, Suite 1, Portland, OR 97210. K-12.

Re: Thinking Recycling. 1987. Available from Alene Cordas, Department of Environmental Quality, Waste Reduction Section, 811 SW 6th, Portland, OR 97204. K-12 activities and information on solid waste divided into 5 age levels.

Super Saver Investigators. 1988. Office of Litter Prevention, Ohio Dept. of Natural Resources, Fountain Square, Building F, Columbus, OH 43224; (614) 265-6444.

Teacher's Guide: Educational Materials In Resource Recovery: Grades K-12. Cathy Berg Moeger, Minnesota Pollution Control Agency, St. Paul, MN: 1984.

Teaching Science With Garbage: An Interdisciplinary Approach to Environmental Education from the Point of View of Science, Mathematics and Social Studies. Vivian and Albert Schatz. Emmaus, PA: Rodale Press, 1971. (4-8) Hard to find, but worthwhile reading. *

The Trash Monster and *The Wizard of Waste* Educational Programs. Sacramento, CA: California Solid Waste Management Board, 1980. Available from California State Department of Education, P.O. Box 271, Sacramento, CA 95802. (2-6) (Approximately $25, includes filmstrip and tape, poster, stickers, teacher's guide, and student workbooks.) Single sets also available free of charge from Casella Waste Management in Rutland. *

Waste: A Hidden Resource. 264 pp. Solid waste management and recycling curriculum guide prepared by junior and high school teachers. Available from: Tennesee Valley Authority, Citizen Action Office, 400 West Summit Hill Drive, Knoxville, TN 37902.

Waste In Place. Stamford, CT: Keep America Beautiful, Inc., 1983.

HOUSEHOLD HAZARDOUS WASTES

*(Materials followed with an * have been reviewed in the course of preparing this Guide and are recommended.)*

Chemical Education for Public Understanding Project (CEPUP) Activity-oriented science modules for Grades 7-12. Contact: Dr. Herbert D. Thier, Lawrence Hall of Science, University of California at Berkeley, Berkeley, CA 94720 (415) 642-8718.

Bags, Beakers, and Barrels. 1986. Industrial States Policy Center and the School of Natural Resource, University of Michigan. Available for $15 from Sue Lacey, Ohio Public Interest Campaign, 1501 Euclid Avenue #599, Cleveland, OH 44115. (216) 861-5200 or the Industrial States Policy Center, 1406 W. 6th Street, Cleveland, OH 44113.

The Dilemma of Toxic Materials: Classroom-tested Ideas and Resources for Social Studies and Science Teachers. Gerald C. Llewellyn, Martin A. Tarter and Marijean Hawthorne. School of Education, Virginia Commonwealth University, Richmond, VA 23284, 1985.

Hazardous Waste Education Kit. Federation of Ontario Naturalists, Ontario, Canada. A resource kit for high school students including an assortment of information pamphlets and lesson plans. Available for $45 + $5 p&h from Ohio Federation of Naturalists, 355 Lesmill Road, Don Mills, Ontario M3B 2W8. *

Household Toxics: A New Curriculum for Grades 4-6. An easy-to-use science and health curriculum designed to fit into a busy classroom schedule. Includes 11 minute videotape "Outta Sight, Outta Mind," six lesson plans (two each grade level), home learning activities, lab demos, and a board game, "The House of Hazards." Topics include what's toxic, warning labels, routes of exposure, safety rules, health effects, environmental concerns, and safer alternatives. Full set of black line masters and informative reference materials. Field-tested in San Diego County schools. Available from the Environmental Health Coalition, 1844 Third Avenue, San Diego, California, 92101, (619)235-0281, for $39.50 (specify VHS or Beta for video).

Sleuth: Educational Activities on the Disposal of Household Hazardous Waste. Claire Dyckman, et al. Seattle, WA: Metro Toxicant Program, Water Quality Division. Report No. 10. August, 1982. *

School Science Laboratories: A Guide To Some Hazardous Substances. Council of State Science Supervisors. 1984. Available free of charge from Ken Giles, U.S. Consumer Product Safety Commission, 5401 Westbard Avenue, Bethesda, MD 20207 (301) 492-6580. Supplements the National Institute on Occupational Safety and Health's (NIOSH) Manual of safety and Health Hazards in the School science Laboratory. Identifies certain potentially hazardous substances in use in many school labs and provides a concise inventory to enable science instructors to take the initiative in providing for proper storage, handling, use and removal of extremely hazardous materials. Provides lists of explosives, carcinogen, highly toxic, and/or corrosive or irritant chemicals.

Teaching about Hazardous and Toxic Materials. John F. Designer and Marylin Lisowski. Columbus, OH: ERIC Clearinghouse for Science, Mathematics, and Environmental Education. A compilation of activities and lesson plans from ERIC database, divided into K-3, 4-6, 7-9, and 10-12. Available for $12.50 from ERIC/SMEAC, The Ohio State University, 1200 Chambers Road, 3rd Floor, Columbus, OH 43212

Toxics In My Home? You Bet! Learning Activities On Household Toxics, Grades K-12. Golden Empire Health Planning Center, 2100 Street, Sacramento, CA 95818 (916) 731-5050. *

RESOURCES C.1.4 CURRICULA AND ACTIVITY BOOKS

REUSE ACTIVITIES AND PROJECTS

*(Materials followed with an * have been reviewed in the course of preparing this Guide and are recommended.)*

Allison, Linda. *Trash Artist's Workshop.* Pitman Learning, 1981.

Blake, Jim and Barbara Ernst. *The Great Perpetual Learning Machine.* Boston: Little, Brown and Co., 1976.

Cliatt, Mary Jo Puckett and Jean M. Shaw. *Junk Treasures: A Sourcebook for Using Recycled Materials With Children.* Englewood Cliffs, NJ: Prentice Hall, Inc., 1981.

Comins, Jeremy. *Art From Found Objects.* New York: Lothrop, Lee, and Shepard Co., 1974.

Criswell, Susie Gwen. *Nature With Art: Classroom and Outdoor Art Activities with Natural History.* Englewood Cliffs, NJ: Prentice-Hall, Inc., 1986.

Fiarotta, Phyllis. *Snips, Snails and Walnut Whales--Nature Crafts for Children.* New York: Workman Publishing Company, 1975.

Graham, Bob. *The Junk Book: A Guide to Creative Reuse of Recycled Materials With Children.* The Five Mile Press, 1984.

Heller, Jules. *Paper-Making.* New York: Watson-Guptill Publications, 1978.

Hennessey, James and Victor Papanek. *Nomadic Furniture Volumes 1 and 2: How to Build and Where to Buy Lightweight Furniture That Folds, Inflates, Knocks Down, Stacks, or is Disposable and Can Be Recycled.* New York: Pantheon Books, 1973.

Hogan, Paul. *Playgrounds For Free: The Utilization of Used and Surplus Materials in Playground Construction.* MIT Press, 1974.

Inoue, B. *Handmade for Kids.* New York: St. Martin's, 1983.

Isaak, Betty. *Garbage Games: Language and Math Games Using Recycled Containers.* Grades 1-4. Santa Barbara, CA: The Learning Works, Inc. 1982.

Jabs, Carolyn. *RE/USES: 2,133 Ways To Recycle and Reuse the Things You Ordinarily Throw Away.* New York: Crown Publishers, Inc., 1982.

Kenny, John B. and Carla. *The Art of Papier Mache.* Philadelphia: Chilton Book Company, 1968.

Linderman, Emma C. *Teachables from Trashables: Homemade Toys That Teach.* Gryphon House.

McPhee, Gribble. *Bottles and Cans: Using Them Again.* Middlesex, England: Puffin Books, 1977.

Simons, Robin. *Recyclopedia: Games, Science Equipment and Crafts from Recycled Materials.* Boston: Houghton Mifflin Company, 1976.

Stribling, Mary Lou. *Art From found Materials, Discard and Notions.* Crown Publishers, 1970.

Studley, Vance. *The Art and Craft of Handmade Paper.* Van Nostrand, 1977.

GENERAL ENVIRONMENTAL

*(Materials followed with an * have been reviewed in the course of preparing this Guide and are recommended.)*

Aquatic Project Wild. Western Regional Environmental Education Council, USA: 1987. (Available free upon completion of six-hour workshop. Contact Vermont Fish and Wildlife Department, Waterbury, VT 05676 (802) 244-7331)*

The Class Project. National Wildlife Federation. Washington, DC: 1982. Units on hazardous substances and other environmental issues.

Connections: A Curriculum in Appropriate Technology for the Fifth and Sixth Grades. Joan Melcher. Butte, MT: National Center for Appropriate Technology, 1980. Approximately $7.

Food For Thought. Marge Dahlin and Elaine Murphy. Developed for The Population Education Project, Washington, DC: Zero Population Growth, 1984. Approximately $20.

The Growing Classroom. $40 from Life Lab Science Program, 809 Bay Avenue, Suite H, Capitola, CA 95010 (408) 476-7140. or contact: Howard Verman, Trinity College, Colchester Avenue, Burlington, VT 05401 (802) 658-7429.

Hands-on Nature. Jenepher Lingelbach. Woodstock, VT: Vermont Institute of Natural Science, 1987. Available from VINS, P.O. Box 68, Woodstock, VT 05091 or in bookstores. $17.95 *

"Oceans." *Naturescope.* Washington, DC: National Wildlife Federation, 1988.

Preserving Man's Environment. Pavoni, Hagerty, Heer. Louisville, KY: Data Courier, Inc., 1974.

Projects in Conservation Series. D.I. Williams and D. Angelesea. England: Wayland, 1978.

Project Learning Tree. Western Regional Environmental Education Council and American Forest Foundation. American Forest Institute, Inc.: 1977. K-6, 7-12 editions. (Available free upon completion of six-hour workshop. Contact Vermont Fish and Wildlife Department, Waterbury, VT 05676 (802) 244-7331)*

Project Seasons. Shelburne Farms, Shelburne, VT.: The Stewardship Institute, 1986. (K-6 seasonal teaching ideas in environmental education) workshops available. Contact: Megan Camp, (802) 985-8686. *

Project Wild. USA: Western Regional Environmental Education Council, 1985. K- 6, 7 -12. Curriculum available at Project Wild Workshops: Contact Vermont Department of Fish and Wildlife.*

"Trees Are Terrific." *Naturescope.* Washington, DC: National Wildlife Federation, 1985. Emphasis on trees with a little on forest resources and recycling. *

RESOURCES C.2.1 FURTHER READING FOR STUDENTS

*(Materials followed with an * have been reviewed in the course of preparing this Guide and are recommended.)*

Adler, Irving and Ruth. *Learning About Steel Through the Story of a Nail.* New York: The John Day Co., 1961. How nails were made, how coal is formed, how a blast furnace operates.

Amazing Life Games Company. *Good Cents: Every Kid's Guide To Making Money.* Boston: Houghton Mifflin Company, 1974. Lots of reuse and recycling ideas. illus. 128 pp. (4-6 and older)

Asimov, Isaac. *ABC's of Ecology.* New York: Walker and Co., 1972. 48 pp. illus. An introduction to ecology, some waste treatment. (4-6)

Beame, Rona. *What Happens To Garbage?* New York: Julian Messner, 1975. 62 pp. illus. photos. Manhattan sanitation workers, waste hauling, landfills, brief look at recycling and energy recovery.

Binzen, Bill. *The Walk.* New York: Coward, McCann and Geoghegan, Inc., 1972.

Bodecker, N.M. *The Mushroom Center Disaster.* Atheneum, 1974. illus. 48 pp. Mushroom-dwelling insect community solves litter problems through creative reuse.

Chargin, Claudia. *It's Your World.* San Francisco: Troubador Press, 1971.

Chester, Michael. *Let's Go to a Recycling Center.* Putnam, 1977. 47 pp. illus. All aspects of recycling process. Good primer for field trips. (4-6)

Cobb, Vicki. *The Secret Life of Hardware: A Science Experiment Book.* New York: J.B. Lippincott, 1982. (4-8)

Cobb, Vicki. *The Secret Life of School Supplies.* New York: JB Lippincott, 1981. Steps involved in the manufacture of paper, ink, pencils, chalk, glue and erasers. Experiments and formulas for making your own supplies. (4-8)

Cox, Victoria and Stan Applebaum. *Nature's Assistant.* New York, NY: Golden Press, 1974.

Davis, Bertha and Susan Whitfield. *The Coal Question.* New York: Franklin Watts, 1982. (6-12)

Edmund, Sean. "The Mess We're In." *Ranger Rick.* Vol. 4, No. 6., (July 1970): 4-10.

Elliot, Sarah M. *Our Dirty Land.* New York: Julian Messner, 1976. 64 pp. illus. Solid waste problems, management options emphasizing recycling and energy recovery; use of public land for private profit; how students effect change by learning more, writing letters, etc.; legislation emphasized as cause and solution to environmental problems. (4-6)

Environmental Action Coalition. *It's Your Environment: Things to Think About ____ Things to Do.* New York: Charles Scribner's Sons, 1976.

Fiarotta, Phyllis. *Snips, Snails and Walnut Whales.* New York: Workman Publishing Company, 1975.

Fisher, Leonard E. *The Glass Makers.* New York: Franklin Watts, Inc., 1964. History and techniques of early american glassmaking.

Fisher, Leonard E. *The Papermakers.* New York: Franklin Watts, Inc., 1965. History and techniques of early American papermaking.

Foote, Timothy. *The Great Ringtail Garbage Caper.* New York: Houghton Mifflin, 1980. 66 pp. illus. Behaviors, minimal treatment of collection and disposal. A story about young garbage entrepreneurs who disturb the local raccoon community's foraging habits. (4-6)

Gabel, Margaret. *Sparrows Don't Drop Candy Wrappers.* New York: Dodd, Mead, 1971. 62pp. illus. Dos and don'ts of individual behavior regarding environmental pollution of all kinds. Builds awareness of interrelatedness with no scientific treatment of subject. (4-6)

Gibbons, Gail. *Paper, Paper Everywhere.* New York: Harcourt, Brace Jovanovich, 1983. Good illustrations. How paper is made and what it is used for. Little reference to recycling or conservation. (K-6) *

Graham, Ada and Frank Graham, Jr. *The Big Stretch.* New York: Alfred A. Knopf, 1985. How rubber bands are made. (4-8) *

Graham, Ada and Frank Graham, Jr. *The Careless Animal: Nine Ecological Detective Stories.* Doubleday, 1975. 95 pp. illus. Interrelationships between human and animal life as affected by technology and invention. Light on hazardous and solid waste. (4-6)

Grummer, Arnold E. *Paper By Kids.* Minneapolis, MN: Dillon Press, Inc., 1980. History of paper and how to make it by hand. *

RESOURCES C.2.2 FURTHER READING FOR STUDENTS

Gutnik, Martin J. *Ecology and Pollution/Land.* Chicago: Children's Press, 1973.

Hahn, James and Lynn. *Recycling--Reusing Our World's Solid Wastes.* New York: Franklin Watts, Inc., 1973. Thorough and concise nonfiction. (4-8)

Harris, Joanna C. *Let's Go to a Sanitation Department.* New York: G.P. Putnam's Sons, 1972. Sanitation departments and waste disposal.

Harwood, Pearl Augusta. *The Rummage Sale of Mr. and Mrs. Bumba.* Minneapolis, MN: Lerner Publications Company, 1971.

Hennings, George. *Keep Earth Clean, Blue, and Green.* 1976. Activities for home and school. Includes solid waste and recycling. (K-8) *

Hilton, Suzanne. *How do They Get Rid of It?* Philadelphia, PA: Westminster Press, 1970. (4-8)

Hoff, Syd. *The Litter Knight.* McGraw-Hill, 1970. illus. Knights, dragons, waste management. 35 pp.

Holliman, Jonathan. *Waste Age Man.* 1979. illus. Human use of limited natural resources in industrial society. Includes problems, solutions, political and social effects. (4-8)

Hughey, Pat. *Scavengers and Decomposers: The Cleanup Crew.* New York: Atheneum Publishers, 1984. 54 pp. illus. Nature's recycling. (4-6)

Hyde, Margaret Oldroyd. *For Pollution Fighters Only.* New York: McGraw-Hill, 1971. 157 pp. illus. Scientific background for community action.

Inoue, B. *Handmade For Kids.* New York: St. Martin's, 1983.

Jones, Claire; Stever Gadler, and Paul Engstron. *Pollution: The Land We Live On.* Minneapolis: Lerner Publications Company, 1974. 102 pp. illus. Ecology, history of land misuse, values. (4-6)

Kataoka, Barbara Slavin. *Pictures and Pollution.* Children's Press, 1977. 39 pp. illus. Fine art representations of environment through history. (4-6)

Keating, Joni. *Use it, Don't Lose It.* Illinois: Good Apple Co., 1981. *

Klagsbrun, Francine. *Read About the Sanitation Man.* Watts, 1972. 69 pp. illus. History of waste management, city waste disposal, waste management options.

Knight Jr., Vick and John E. Moore. *It's Our World.* Charter School Books, 1972. 152 pp. illus. Intro to ecology and environmental problems. Space ship earth theme; simple experiments suggested.

Lauber, Patricia. *Too Much Garbage.* Chicago, IL: Garrand Publishing Co., 1974. 64 pp. photos. Nonfiction covering garbage from home, packaging, community waste management, landfills, incineration, and recycling.

Lawrence, Ester Hauser. *B-9, The Hungry Metal Eater.* New York: Rand McNally, 1970.

Leaf, Munro. *Who Cares? I Do.* illus, photos. J.B. Lippincott, 1971. 35pp. Littering, individual responsibility and action.

Lefkowitz, R.J. *Save It! Keep it! Use It Again! A Book About Conservation and Recycling.* New York: Parents Magazine Press, 1977. 62 pp. illus. Nonfiction. (4-6)

Lipsett, Charles. *100 Years of Recycling.* 1974. All major developments in recycling, successful and failed projects in private and public sectors. (9- 12 to adult)

Lyth, Mike. *The War On Pollution.* Priory Press, 1977. 87 pp. photos. Family and global polluting examples including packaging, pesticides, solid waste and recycling.

Mackenzie, Joy, and Imogene Forte. *Kid's Stuff: Social Studies.* Nashville, TN: Incentive Publications, 1976.

Marshall, James. *Going to Waste.* New York: Coward, McCann and Geogheagan, Inc., 1972. Out of date on waste-to-energy plants; otherwise useful background on packaging, changing habits, and increasing recycling potential. (4-6)

McCue, George. *Ecology: The City.* Benzinger, 1971. 64 pp. illus. Includes disease and waste disposal, landfill and incineration. (4-6)

Miles, Betty. *Save the Earth! An Ecology Handbook for Kids.* New York: Alfred Knopf, 1974. illus. photos. (K-6) *

Milgrom, Harry. *ABC of Ecology.* Macmillan, 1972. 30 pp. illus. photos. Alphabet of pollution concepts, science emphasis.

Moore, Lillian. *Junk Day on Juniper Street.*

Peet, Bill. *The Wump World.* Boston: Houghton Mifflin Company, 1970. 44 pp. illus. Pollutians from planet Pollutus almost destroy the pleasant, clean world of the Wumps. (K-3)

RESOURCES C.2.3 FURTHER READING FOR STUDENTS

Pflug, Betsy. *You Can.* New York: Van Nostrand Reinhold Co. Reuse ideas using cans. (K-3)

Poulet, Virginia. *Blue Bug's Beach Party.* Chicago: Children's Press, 1975. 31 pp. illus. Litter clean-up.

Pounds, Elenore. *Wastebasket Full, Wastebasket Empty.* New York: Scott Foresman and Co., 1974.

Prelutsky, Jack. *Read Aloud Rhymes For The Very Young.* New York: Alfred A. Knopf, 1986.

Pringle, Lawrence. *Recycle Resources.* New York, NY: Macmillan Publishing Co., 1974.

______. *Throwing Things Away: From Middens to Resource Recovery.* New York: Thomas Y. Crowell, 1986. Describes the phenomenon of garbage, what it can indicate about particular cultures, and past and present problems and methods of solid waste disposal and management. (4-12) *

Rippy, Rachel, ed. *Finding and Using Scrounge Materials.* Washington, DC: Office of Education, 1975. Project ideas for reusing waste materials.

Rockwell, Harlow. *The Compost Heap.* Garden City, NY: Doubleday & Co., Inc., 1974. Simple, nicely illustrated. (K-6) *

Seuss, Dr. *The Lorax.* Random House, 1971. 63 pp. illus. Depleting natural resources and polluting the earth. All ages. *

Seymour, John. *Blueprint For A Green Planet: Your Practical Guide to Restoring the World's Environment.* New York: Prentice Hall, 1987. (7-12) *

Shanks, Ann Zane. *About Garbage and Stuff.* New York: The Viking Press, Inc., 1973. 36 pp. illus. photos. Trash, landfills, recycling glass, metal, paper. Reduce waste through conservation and reuse. Story about a family's recycling efforts and children's participation. (1-3)

Showers, Paul. *Where Does the Garbage Go?* New York: Thomas Y. Crowell, Co., 1974. 33 pp. Good illustrations. Problems of dumping and burning, solutions, waste composition, urban vs. rural disposal, energy recovery process.

Shuttlesworth, Dorothy E. *Litter - The Ugly Enemy: An Ecology Story.* Garden City, NY: Doubleday, 1973. 61 pp. illus. photos. Students and teachers begin to solve local waste and litter problems. Recycling, litter prevention, community efforts. Reads easily. (3-6)

Silverstein, Shel. "Hector the Collector" and "Sarah Cynthia Sylvia Stout Would Not take The Garbage Out," *Where The Sidewalk Ends.* New York: Harper and Row, 1974. 164 pp. illus. *

Simon, Seymour. *Science Projects in Pollution.* New York: Holiday House, 1972.

Simons, Robin. *Recyclopedia. Games, Science Equipment, and Crafts from Recycled Materials.* Boston: Houghton Mifflin Company, 1976. (K-8) *

Smaridge, Norah. *Only Silly People Waste.* Abingdon, 1976. 28 pp. illus. Conservation principles through poetry.

Smaridge, Norah. *Litterbugs Come In Every Size.* Racine, Wisconsin: Western Publishing Co., 1972. "Litterbugs" vs. "Neatos" in rhyme.

Smith, Norman F. *The Inside Story of Metal.* New York: Julian Messner, 1977. (7-12)

Smith, Norman F. *If It Shines, Clangs & Bends, It's Metal.* New York: Coward, McCann & Geoghegan, Inc., 1980. illus. History, use, and characteristics of metal, importance of conservation and recycling. (4-8) *

Soucie, Anita. *Sharing the Earth.* New York: Scholastic Book Services, 1971.

Steinbert, Barbara. *Who Keeps America Clean?* 1976. Career opportunities in environmental protection. Includes a recycling plant manager. (5-8)

Stone, Harris. *The Last Free Bird.* Englewood Cliffs, NJ: Prentice Hall, Inc., 1967. Effects of pollution. (K-3)

Tisho, Annette and Talus Taylor. *Barbapapa's Ark.* Middletown, CT: Xerox Educational Publications, 1974.

Tresselt, Alvin. *The Dead Tree.* New York: Parent's Magazine Press, 1972. 15pp. illus. Poetic story emphasizing decomposition part of the life cycle of a tree.

United States Environmental Protection Agency. *Earth-Trek...Explore Your Environment.* Washington, DC: US Government Printing Office, 1977.

Weinber, Stanley. *Action Biology: Ecology.* New York: Scott Foresman, 1974.

Wentworth, D.F., J.K. Couchman, J.C. Macbean, and A. Stecher. *Pollution: Examining Your Environment.* Toronto: Holt, Rinehart and Winston of Canada, Limited, 1971.

Wright, Dare. *Edith and Little Bear Lend A Hand.* New York: Random House, 1972. 54 pp. illus. A bear family living in the city begin recycling to help clean up. (K-3)

What Are Me and You Gonna Do?: Children's Letters to Senator Gaylord Nelson about the Environment. Ballantine, 1971. 63 pp. illus. In response to Earth Day 1970, covering all environmental aspects.

Wildsmith, Brian. *Professor Noah's Spaceship.* Oxford, 1980. 30 pp. illus. Animals solve the plight of living in a world polluted by humans by flying in a spaceship to an unpolluted earth of the past.

Wong, Herbert H. and Matthew F. Vessel. *Our Tree.* Wesley, MA: Addison- Wesley, 1969.

Woods, Geraldine and Harold. *Pollution.* New York: Franklin Watts, 1985.

Zion, Gene. *Dear Garbage Man.* New York: Harper and Row, 1957.

SOLID WASTE AND RECYCLING

(AVR) indicates that this video belongs to the AVR Library and/or is part of an AVR Traveling Resource Center. Contact AVR (802) 229-1833 for more information.

Alu Man The Can. Animated. (K-3) 1/2" VHS $25. (3/4" $35) 1987. Purchase from: Ricki Kashdan, Public Education and Risk Communi-cation Division, Environmental and Occupational Health Sciences Institute UMDNJ-Robert Wood Johnson Medical School, trailer #2, 675 Hoes Lane, Piscataway, NJ 08854-5635. (201) 463-4500. (AVR)

Aluminum Recycling: Your Next Assignment. VHS. Free loan from The Aluminum Association. $35 purchase or free loan from Modern Talking Picture Service, 500 Park Street North, St. Petersburg, FL 33709. (813) 541-5763. (AVR)

Buy Recycled Products - They're worth our environment. (47 slides with cassette) 10 minutes. Promoting purchase of Michigan recycled products. Reasons to buy goods manufactured from recycled materials. Also, uses of re-refined motor oil, plastic lumber, retreaded tires, shredded newsprint products, recycled paperboard, recycled printing papers. Free 10-day loan from Michigan Department of Natural Resources, Waste Management Division, Resource Recovery Section, Lansing, MI 48909 (517) 373- 0540.

Choices - Adelphi Productions; 1/2" VHS format videotape. 14 minutes. features the residents of a community that made a choice to replace an overflowing landfill with a resource recovery facility to dispose of their waste and convert it to energy. Free 10-day loan from Michigan Department of Natural Resources, Waste Management Division, Resource Recovery Section, Lansing, MI 48909 (517) 373-0540.

Closing the Loop. California Solid Waste Management Board, 1980. Filmstrip with tape, 10 minutes, color. (AVR)

Cycles. 14 min. 16mm. 1972 Glass Container Manufacturing Institute. Loan from Environmental Action Coalition.

Energy Where You Least Expect It. 28 min. Color, $450p, $45r, 1982. Producer and Distributor: Third Eye Films. Also available from the Wisconsin Department of Natural Resources. Large and small waste-to-energy projects including incineration, methane recovery, refuse-derived fuels, recycling. Addresses the issues of financing, plant efficiency, air pollution, and energy distribution.

Garbage. 11 min. General audience. color 16mm. 1970. Shows fanatically neat people juxtaposed with those totally indifferent. Illustrates disposal systems struggling to keep up with an ever-increasing flow of garbage created by our affluent society. $12 Rental from Syracuse University Film Rental Center, 1455 East Colvin St., Syracuse, NY 13244-5150 (800) 223-2409 # 1-9466.

Garbage Explosion. 16 min. 7-12. color 16mm. 1970. Investigates the nature, volume and composition of solid waste, which includes a growing proportion of less destructible paper, metal, plastic and glass. Presents advantages of current disposal methods and shows possible long-range solutions. From "Ecology and Environmental Science" series. $12 Rental from Syracuse University Film Rental Center, 1455 East Colvin St., Syracuse, NY 13244-5150 (800) 223-2409 #2-8130.

The Garbage Monster. Environmental Action Coalition. Slides with script. Order from EAC, 625 Broadway, NY, NY, 10012; (212)617-1601.

The House that Recycling Built. Richmond, VA: Reynolds Metals Company, 10 mins. 1973. 16mm. #112 (educator's guide to free films) (4-6)

JunkDump. 20 min. color. 16mm. 1971. Comic and tragic portrayal of a day in the life of a husband and wife who go about their "normal" activities in the midst of the accumulation of waste material. Both characters seem to have resigned themselves to their terrible conditions, bringing audience to the conclusion that what is witnessed might well happen soon, if the solid waste disposal problem is not solved. $13 rental from Syracuse University Film Rental Center, 1455 East Colvin St., Syracuse, NY 13244-5150 (800) 223-2409 2- 10150. (7-12 to adult)

Junk Ecology - filmstrips with cassettes. Step by step for converting household trash items into practical or decorative items. Grades 3-6: Set 1 Recycling Paper and Cardboard, Recycling wood Sticks; Set 2 Recycling Plastic Throw Aways, Recycling Tin Cans and Bottle Caps; Set 3 Recycling Jars and Bottles, Fix Up, Clean Up: Special Crafts. $41.20 for six. Troll Associates.

In the Bag. Burbank, CA: Walt Disney Productions, 8 minutes. Features Humphrey the Bear and his problems in cleaning up a littered park. (K-3)

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Industry Recycles. California Solid Waste Management Board, 1980. 10 minutes, color. (filmstrip and tape) (7-12) (AVR)

Leaf Composting. VHS. 30 min. Narrated by a backyard gardener discussing principles of composting as well as construction of compost pile and uses of compost produced. Free 10-day loan from Michigan Department of Natural Resources, Waste Management Division, Resource Recovery Section, Lansing, MI 48909 (517) 373-0540.

Light at the End of the Pipe. 1/2" VHS. by Argonne National Lab. 1979. methane recovery. Free 10-day loan from Michigan Department of Natural Resources, Waste Management Division, Resource Recovery Section, Lansing, MI 48909 (517) 373-0540.

The Litterbug. Walt Disney Productions, 1955. 16mm, 10 minutes, color. When a teacher shows a film about the beauty of uncluttered landscapes, contrasted with the ugliness and danger of littered areas, Lyle is impressed with the lesson and becomes determined to stop being a litterer. Bureau of Audiovisual Services, University of Arizona, Tucson. (K-3)

The Mountain in the City: New York's material use and disposal crisis. Produced by New York State Legislative Commission on Solid Waste Management. #313. 52 min. VHS format. (High School-Adult) Free 10-day loan from Michigan Department of Natural Resources, Waste Management Division, Resource Recovery Section, Lansing, MI 48909 (517) 373-0540.

The Need To Know. Dow Chemical Company, Inc. 1982. 16mm. 28 minutes. Chemical manufacturing and waste disposal.

Organic Gardening: Composting. Rodale Press. 11 minutes. Grades 3-Adult. Using live action and animation, the film shows how to build a compost heap, what ingredients to use, in what proportions, how to layer the heap to ensure speedy and uniform decomposition, and what kinds of containers you can use. 16mm $225, Video $60 purchase or $20 rental from Bullfrog Films, Oley, PA 19547 (800) 543-FROG.

Plastics Recycling Pilot Plant: A Video Tour. 6 minutes. Tour of Rutger's Center for Plastics Recycling Research. Free loan or $20 purchase from Plastics Recycling Foundation, 1275 K Street, N.W., Suite 400, Washington, DC 20005. (202) 371-5200.

Recyclemania. A cassette tape of music on recycling by Billy B., a nationally established children's musician and performer; appropriate for upper elementary students. Available for $7 from Do Dream Music, P.O. Box 5623, Takoma Park, MD 20912.

Recycling. 1971. 20 minutes, (7-12) Midwest Regional Library, Berlin, VT. Rental.

Recycling: A Way of Life. Aluminum Association, 1980. 16mm. or VHS. (7-12) 15 minutes. Footage of aluminum recycling process but no explanation of exactly what you're seeing. Free loan from Modern Talking Picture Service, 5000 Park Street North, St. Petersburg, FL 33709. (813) 541-5763.

Recycling in Action. 14 min. 7-12 to adult, color. Film Fair 1973. Establishes the need for recycling and then makes a general introduction to community-type volunteer reclamation centers, showing preparation of recyclables for market. $12 rental from Syracuse University Film Rental Center, 1455 East Colvin St., Syracuse, NY 13244-5150 (800) 223-2409 # 2- 10563.

Recycling: The Need Is Clear. 12 minutes. Describes glass recycling programs nationwide. Glass Packaging Institute.

Recycling: Waste Into Wealth. Pathway Productions. 1/2" VHS. 29 minutes. Sale $450 (16mm) or $175 (video); Rental $55 (postage paid) from Bullfrog Films, Oley, PA 19547 (800) 543-FROG. Grades 5-Adult. Study Guide and Resource Guide accompany film. Shows how to prepare materials, curbside collection; drop-off centers, processing of materials, etc.

Rubbish to Riches. Lindenmeyer Films, 1979, 11 minutes, 16 mm, color. (7-12) Waste products, instead of being dumped, can be separated into energy- producing, burnable materials and reclaimed iron, steel and aluminum. This film shows some of the ways waste products can be converted into fuel and trash can be recycled into these usable products. Free loan from Energy Information Center, Vernon, VT.

Sanitary Landfill. Washington, DC: NACD, Distribution Branch, National Audiovisual Center, (GSA), Washington, DC 15 min. A sanitary landfill foreman describes his job. (4-6)

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Sesame Street, Volume III. People In Your Neighborhood; Somebody Come and Play; Goin' for a Ride; Trash. n.p.: Troll Associates. K-3 (cassette)

The Soiled Frontier. Air, water, solid waste pollution problems in Oregon. auto exhausts, oil, tires, junkcars, litter, bottle bill, estuary landfill. personal commitment, small actions count, shows successful clean-ups, etc. State of Oregon Environmental Report. 27 minutes. 1973. color. Oregon Division of Continuing Education.

Solid Waste Management. Bethel/Royalton Solid Waste Committee's video produced by Stu MacGowan and 7th and 8th graders from South Royalton and Witcomb High Schools. Available from Stu MacGowan, ppd. $22.50, c/o Union Video, 1 Main St., Burlington, VT (802) 863-1046 (4-12) (AVR)

Space Station: EARTH. A Recycling Video Program for 4th-5th Grades. Solid Waste Management Division, Snohomish County Public Works, 4th Floor, County Administration Building, Everett, WA 98201. Contact: David M. Polis. $40. (206) 259-9425. (AVR)

Technology and Trash. 16mm and VHS. (7-12) Describes how landfills work. Produced by Caterpillar. Free loan from Modern Picture Talking Service 5000 Park Street North, St. Petersburg, FL 33709. (813) 541-5763.

The Trash Monster. 12 minute filmstrip, (part of Trash Monster Education Kit, Grades K-6) California Solid Waste Management Board, 1020 9th Street, Suite 300, Sacramento, CA 95814. (AVR)

Virginia Tire Fire. U.S. Coast Guard. Atlantic Strike Team; Elizabeth City, North Carolina; 1/2" VHS. 13 minutes. Illustrates the extensive fire hazard associated with discarded tire stockpiles and US coast guard efforts to control a serious tire fire in Virginia. Free 10-day loan from Michigan Department of Natural Resources, Waste Management Division, Resource Recovery Section, Lansing, MI 48909 (517) 373-0540.

Wealth out of Waste. Washington, DC: Bureau of Mines, U.S. Department of the Interior, Cochrans Mill Rd. P.O. Box 18070, Pittsburgh, PA 15236. Free loan. Outdated but useful - explains secondary recovery techniques presently in use or experimentally in operation throughout the U.S. (upper elementary through adult)

Waste. Lynn Corcoran, 1985. 29 minutes, Grades 7-Adult. Connects consumer habits, from the individual to the multinational, with the waste problem. Views common and uncommon examples of the generation, disposal and re-use of a variety of wastes including toxics, municipal, sewage, space waste. Video purchase $150, rental $50 from Bullfrog Films, Oley, PA 19547 (800) 543-FROG. (AVR)

Waste: Recycling The World. 1972. 24 minutes, color. Grades 9-Adult. Waste disposal problems. Highlights outdated information about New York City. From "Towards the year 2000" series. $22 rental from Syracuse University Film Rental Center, 1455 East Colvin St., Syracuse, NY 13244-5150 (800) 223-2409 # 3-10209.

Waste to Energy. Part I: Questions to Consider and Part II: Planning the project. 1/2" VHS. 22 minutes. Produced by University of Wisconsin. Free 10-day loan from Michigan Department of Natural Resources, Waste Management Division, Resource Recovery Section, Lansing, MI 48909 (517) 373-0540.

Waste to Energy. California Solid Waste Management Board, 1980. 10 minutes, color, (filmstrip and cassette). (AVR)

Waste Not, Want Not. Windham County Solid Waste District, 1987. Explores the factors influencing increasing waste generation and provides useful information on how a landfill operates (footage from the Windham County municipal landfill) and recycling as a waste management technique. Viewers see what really happens at a recycling processing center. Other topics covered include methane recovery from the landfill, composting, waste reduction and reuse. (Grades 6-Adult). Available by loan from Windham County Solid Waste District. (AVR)

The Wasting of Vermont. Agency of Natural Resources, 1988. Provides information about Vermont's solid waste disposal problems and what has to be accomplished in order to solve these problems. Shows community and home recycling efforts and interviews state employees, private businesses, residents, and solid waste managers to give viewers a well rounded perspective of what is happening in Vermont. (Grades 8-Adult). Available from Agency of Natural Resources (800) 932-7100. (AVR)

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Wizard of Waste. 12 min. filmstrip (K-3) part of Wizard of Waste Educational Kit. California Solid Waste Management Board, 1020 9th St., Suite 300, Sacramento, CA 95814. (AVR)

Woodsy Waste Wise. (K-6) and Waste Wise (7-12, adult). Cornell Media Services, Audio Visual Resource Center, Building 8, Research Park, Ithica, NY 14850; (607) 255-2091. Contact: Rich Grey. Slides, tape and script, with activities. Rental $14, purchase $39 and $47 respectively.

The following videos are available from Roger Bailey, Video-Active Productions, Box 322, Route 2, Canton, NY 13617; (315) 386-8797.

W.O.W. 1: Auburn, Maine Incinerator. 1982. 20 minutes. Describes general problems with incineration and discusses merits of the alternatives.

W.O.W. 2: Rome, NY Incinerator. 30 minutes. Covers citizens' concerns about the plant and some of mechanical problems in the first year of operation.

W.O.W. 4: Interview with Bernd Franke. 22 minutes. Describes a study by the Institute for Energy and Environmental Research in Heidelburg, Germany which compared nine different methods of handling waste and found that by far the best method was a combination of mandatory source separation, composting and recycling.

W.O.W. 5: Windam, CT Incinerator. 60 minutes. Tour of plant and interviews with concerned local residents.

W.O.W. 6: Recycling in Germany. December 1986, 60 minutes. Shows source separation programs, a separation plant for mixed recyclables, a factory recycling mixed plastics, an in-vessel composting plant, drop-off recycling containers and toxic removal efforts.

W.O.W. 7: Recycling in the USA: Don't Take "No" For An Answer. 60 minutes. Focuses on four individuals: 1. Joe Garbarino, a waste hauler from Marin County, CA; 2. Peter Karter, an engineer from Connecticut; 3. Mark Lohbauer, a lawyer and council member from Pennsauken, NJ; and 4. David Birbeck, the second selectman from Stonington, CT. Each is associated with a successful recycling program and each has been unwilling to be discouraged by pessimists.

W.O.W. 8: Skamania County, Washington: Materials Recovery Facility. 47 minutes. July 1987. Located in rural Skamania County (population 10,000) this facility can handle the complete waste stream and has reduced the volume of materials going to the landfill by 65-60%.

W.O.W. 9: Joe Garbarino: The Only Way To Go. The Marin County, CA Materials Recovery Plant. 33 minutes. August 1987. Joe Garbarino talks about the past, present and future aspects of the garbage crisis and the separation facility and curbside collection programs he successfully operates.

W.O.W. 10: Millie Zantow: Recycling Pioneer. 48 minutes. September 1987. Features Millie Zantow from North Freedom, Wisconsin. Millie's energy and vision is behind this successful operation which utilizes part time and volunteer work.

W.O.W. 11: Zoo Doo and You Can Too. February 1988. 59 minutes. Begins with the composting programs at the Woodland Park Zoo in Seattle, WA, and presents a low tech approach to compost animal manure, food waste and yard waste. A "Home Composting" set up, oriented toward children, is also featured. The second part of this tape shows many different methods of composting.

W.O.W. 16: Waste Management As If The Future Mattered. June 1989. 60 minutes. Primarily footage of lectures by Dr. Paul Connett covering all aspects of solid waste management. (Grades 10-Adult). (AVR)

HOUSEHOLD HAZARDOUS WASTES

Beginning at Home: Tackling Household Hazardous Wastes. VHS, Beta or 3/4- inch cable. 18 minutes. 1986. Available for rental ($25, $10 non-profit) or sale ($75, $30 non-profit) from The League of Women Voters of Massachusetts, 8 Winter Street, Boston, MA 02108. (617) 357-8380. (Make checks payable to "Scharfman Fund, LWVM")

Household Hazardous Wastes: Everyone's Problem. Audio Slide Show. 19 minutes. 10-Day Rental $25, non-profit $15; Purchase $100, non-profit $65 from League of Women Voters of Massachusetts, 8 Winter Street, Boston, MA 02108 (617) 357-8380. Include a $30 refundable deposit, give 6 weeks notice for rental and make checks payable to: Scharfman Fund, LWVM.

Toxic Chemicals: Information is the Best Defense. Part I. Who Needs to Know? Part II: Developing a Community Right to Know Law. 26 minutes each. Grades 9-Adult. League of Women Voters of California, 1986. Rental or purchase from Bullfrog Films, Oley, PA 19547 (800) 543-FROG.

The Environmental Health Coalition, 1844 Third Avenue, San Diego, California, 92101, (619)235-0281 offers the following audio-visual aids:

Outta Sight, Outta Mind. 11 minutes (1988). Made for children (8-12 yrs), this program focuses on the health effects of household hazardous materials and pollution due to improper disposal. A boy and his grandfather visit a polluted lake closed to fishing and discuss what's toxic, how they enter the body, safer substitutes, and recycling waste oil. Safe use, storage and disposal of household hazardous materials also covered.

Safer Pest Control (for Amateur Exterminators). 30 minutes (1988). What can you do to control insects without toxic pesticides? Environmentalist Sharon Taylor demonstrates practical (and sometimes comical) methods to control five common indoor pests. Organic gardening experts explain keys to preventing insects and weeds in the garden.

Safe Substitutes (Slideshow). 15 minutes; 120 slides/carousel/audio tape. Environmental Health Coalition has identified safer products and techniques for cleaning your home and controlling pests. This slide show presents practical information to use for safer home management

Toxics in the Home. 29 minutes (1985). Presents the use, storage and disposal dilemmas related to household toxic materials. Health and hazardous materials professionals identify problems and suggest solutions. Common household products are featured and their hazards examined.

RELATED ENVIRONMENTAL AND ENERGY CONSERVATION FILMS

America's Wetlands. 16mm. 28 minutes. Exploration of American wetlands, their role as wildlife habitat, and necessity to protect these valuable ecosystems. Free loan from Vermont Fish and Wildlife.

The Lorax. Dr. Seuss. Available from most video rental stores. (All ages)

Nature's Way. 16 mm., 13 minutes. Life on a small pond from microorganisms to man. Free loan from Vermont Fish and Wildlife. (K-6)

Pigopolis. Industrial Media, 1980, 12 minutes, 16 mm, color. Animated illustration of energy resources, conservation, and wise energy use. A city of pigs, uses energy in excess to the point of endangering themselves. Includes teacher's activity guide. Free loan from Energy Information Center, Vernon, VT. (K-6)

Toast. Earth Chronicles, 1974. 12 minutes, 16mm, color. Images set to music illustrating the energy-intensive preparation and marketing of food. Free loan from Energy Information Center, Vernon, VT.

*(Materials followed with an * have been reviewed in the course of preparing this Guide and are recommended.)*

Abelson, Philip H. "Municipal Waste -- Editorial." *Science.* Volume 236, Number 4807. June 12, 1987., p. 1409.

Begley, Sharon. Ginny Carroll and Tim Padgett. "Don't Go Near The Water." *Time.* August 1, 1988. *

Brown, Lester R. *Building A Sustainable Society.* New York: W.W. Norton & Co., 1981.

Brown, Lester et al. *State of the World: A Worldwatch Institute Report on Progress Toward a Sustainable Society.* New York: W.W. Norton and Co., 1987. "Realizing Recycling's Potential" by Cynthia Pollock.

Budiansky, Stephen. "Tons and tons of trash and no place to put it." *U.S. News and World Report.* December 14, 1987.

The Burning Question: Garbage Incineration vs. Total Recycling in New York City. 188 pp, 1986. $27.50. NYPIRG, 9 Murray St., NY, NY. 10007.

Cate, Richard, Kenalene Collins, Nancy Everhart and Jonathan Lash, "Cleaning Up Solid Waste." *Vermont Affairs.* Winter 1988.

Characterization of Municipal Solid Waste in the United States, 1960-2000. Prairie Village, KS: Franklin Associates, Ltd., 1986. (Prepared for the US EPA.)

Concern, Inc. *Waste: Choices for Communities,* 1988. A publication for concerned citizens on waste disposal practices and the local benefits of recycling. 32 pp., Available for $3 from Concern, Inc., 1794 Columbia Rd., N.W., Washington, DC 20009.

Cousteau, Jacques-Yves and the staff of the Cousteau Society. *The Cousteau Almanac: An Inventory of Life on Our Water Planet.* Garden City, NY: Doubleday & Co., Inc., 1981. *

Crawford, John F., and Paul G. Smith. *Landfill Technology.* London: Butterworths, 1985. (UVM)

Dean, Virginia. "Where is it Going?" *Upper Valley* Volume 3, Number 5 (January/February 1989) p. 17. (disposal of medical wastes)

Deagan, Kathleen. "Tracing the Waste Makers." *Archaeology.* (January/February 1989). pp. 57-61.

Durrell, Lee. *State of the Ark: An Atlas of Conservation in Action.* London: Gaia Books Limited, 1986. *

Franklin, William E. Marjorie A. Franklin and Robert G. Hunt. *Waste Paper: The Future of a Resource 1980-2000.* New York: American Paper Institute, 1982.

"Garbage: A 413,000 Ton-A-Day Dilemna." *Inform Reports* 1985 May-June; Volume 5(3). Inform Inc. 381 Park Avenue South. New York, NY 10016 212-629- 4040. 1985. mass-burn, resource recovery, solid waste.

Lang, John S. "The Disposable Society -- Editorial." *U.S. News and World Report,* June 1, 1987, p. 68.

Lundberg, Kenneth V. "My Twenty Foot Swath." Chicago Ill: Covenant Press. Evangelical Covenant Church of America. Covenant Companion. October, 1982. p. 8-9.

Meadows, Donella H. "The New Alchemist." *Harrowsmith.* November/December 1988. pp. 38-47. Alternative waste-water treatment systems. *

Melosi, Martin V. *Garbage in the Cities: Refuse, Reform, and the Environment, 1880-1980.* College Station: Texas A & M University Press, 1981.

Morris, David and Neil Seldman. "New Ways to Keep a Lid on America's Garbage Problem," *Wall Street Journal,* April 15, 1986.

Myers, Dr. Norman. *Gaia: An Atlas of Planet Management.* Garden City, NY: Anchor Press Doubleday and Co., Inc. 1984. Colorful fully illustrated overview of global environmental issues. (p.136, 137 deal with recycling). *

Neal, Homer A. and J.R. Schubel. *Solid Waste Management and the Environment: The Mounting Garbage and Trash Crisis.* New York: Prentice-Hall, Inc., 1987.

O'Leary, Philip R., Patrick W. Walsh, and Robert K. Ham. "Managing Solid Waste." *Scientific American,* December 1988. pp. 36-42.

Packard, Vance. *The Waste Makers.* 1960. Discussion of institutionalized waste generation, planned obsolescence.

Pringle, Lawrence. *Throwing Things Away: From Middens to Resource Recovery.* New York: Thomas Y. Crowell, 1986. *

Purcell, Arthur H. *The Waste Watchers: A Citizen's Handbook for Conserving Energy and Resources.* Garden City, NY: Anchor Books, 1980. Practical waste- reducing strategies from reuse to lobbying. *

Purcell, Arthur H. "The World's Trashiest People -- Will They Clean Up Their Act?" *The Futurist*, February 1981. pp. 51-59.

"Putting 220 Tons of Garbage A Day Where It Belongs," *Christian Science Monitor*, March 10, 1983.

Raloff, J. "Are Landfills A Major Threat to Climate?" *Science News*, Vol. 131, No.10. March 7, 1987. p. 150.

Robinson, William D. *The Solid Waste Handbook*. New York: John Wiley and Sons, 1986. Solid waste management from industry perspective; includes legislation, financing, legal issues, etc.

Schwab, Jim. "Garbage In, Garbage Out." *Planning*. Vol. 52, No. 10. October 1986. pp. 4-9.

Seldman, Neil and Huls, Jon. "Beyond the Throwaway Ethic." *Environment*, Vol. 23, No. 9, pp. 25-36.

Seymour, John and Herbert Girardet. *Blueprint for A Green Planet: Your Practical Guide to Restoring the World's Environment*. Prentice Hall Press, NY: 1987. *

Sloane, Eric. *Once Upon A Time: The Way America Was*. New York: Hastings House Publishers, 1982.

A Solid Waste Blueprint For New York State. New York: Natural Resources Defense Council, Environmental Defense Fund, INFORM, Environmental Action Coalition, Scenic Hudson, March, 1988. Available from Natural Resources Defense Council for $10, $5 for members. Recommendations to NY DEC, focus on pollution controls for incinerator operations and ash disposal with waste reduction and recycling strategies.

"Solid Waste Management: Taking the Integrated Approach." *New Hampshire Town & City*. April 1988.

State of Vermont Solid Waste Management Plan. Solid Waste Management Division, Department of Environmental Conservation, Agency of Natural Resources, State of Vermont, Draft: March 1988; Adopted revision: October 1988.

State of Vermont Solid Waste Management Rules. Solid Waste Management Division, Department of Environmental Conservation, Agency of Natural Resources, State of Vermont, January 1989.

Taylor, Ronald A. et. al., "Another Day Older and Deeper In Trash", *U.S. News and World Report*, May 11, 1987. pp. 20,21.

Tedford, Ted. "Vt. Trash Scene Changing -- On heels of new solid waste law, firms buying up haulers." *The Burlington Free Press*. March 28, 1988.

Troubled Waters, "The World's Oceans Can't Take Much More Abuse." *Business Week*, October 12, 1987. pp. 89-102.

Truax, Hawley. "Built To Last" *Environmental Action*. March/April 1988, p. 9. Tires disposal and recycling.

Underwood, Joanna D., Allen Hershkowitz and Maarten de Kadt. *Garbage: Practices, Problems & Remedies*. New York: Inform, Inc., 1988. 25 pp. *

White, Peter. "The Fascinating World of Trash." *National Geographic*. Vol. 163, No. 4. April 1983. pp. 424-457. *

Wirka, Jeanne. "Move Over, Garbage Barge." *Environmental Action*. November/December 1987. p. 8.

The World Resources Institute, The International Institute for Environment and Development, in collaboration with the The United Nations Environment Programme. *World Resources 1988-89*. New York: Basic Books, Inc., 1988.

*(Materials followed with an * have been reviewed in the course of preparing this Guide and are recommended.)*

Barry, Patrick. "Cities Rush To Recycle." *Sierra.*

Barry, Patrick. *Recycling -- An Economic Development Opportunity: An Assessment of Community Recycling Programs Supported By The Department of Economic Development.* Department of Economic Development, City of Chicago, May 1987.

Bartone, Carl. "Recycling Waste: The World Bank Project On Resource Recovery." *Development* (Soc. Internat. Development) p. 35-9 No.4, 1986.

Bazilchuk, Nancy. "Recycling. New Solid Waste Law Provides Foundation" The *Burlington Free Press.* February 7, 1988.

Chandler, William U. "Converting Garbage To Gold -- Recycling Our Materials" *The Futurist,* February 1984. pp. 69-77.

______. *Materials Recycling: The Virtue of Necessity.* Worldwatch Paper 56. Washington, DC: The Worldwatch Institute, 1983. *

Civic Action Institute. *Community-Based Waste Recycling: A Neighborhood Action Guide.* Three operating examples of how to set up a recycling service. Available from: ILSR, 2425 18th Street, NW, Washington, DC 20009. 1979.

The Connecticut Fund for the Environment. *Don't Throw This Away.* New Haven, CT: The Connecticut Fund for the Environment, 1987. (32-page book full of information about New Haven recycling with general information and resources. A good idea book for developing a local publicity and public education campaign.) Available from: CFC, 152 Temple Street, New Haven, CT 06510 for $1. *

Environmental Defense Fund. *Coming Full Circle: Successful Recycling Today.* New York, Environmental Defense Fund, 1988. Guide to large-scale recycling nationwide for citizens, officials and community organizers. Available for $12 from from EDF, 257 Park Avenue South, NY, NY 10010.

Franchot, Peter. *Bottles and Cans: The Story of the Vermont Deposit Law.* Montpelier, VT: Vermont Natural Resources Council, 1978.

Goldstein, Jerome. *Garbage As You Like It.* 1971.

_______. *Recycling - How to Reuse Wastes in Home, Industry, and Society.* New York: Schocken Books, 1979. *

Guide for Implementing an Office Paper Recovery Project. Ontario, Canada: Ministry of the Environment, 1987.

A Guide to Recycling the Source Separation Way. Indiana State Board of Health, 1330 Michigan Street, Indianapolis, IN 46206. Describes markets for separated materials, examples of collection systems, sample contracts, recycling ordinances, etc.

Handbook on Plastics Recycling and Action Plan for Increased Plastics Recycling in Canada. Environmental Protection Service, Envir. Canada, 25 St. Clair Avenue East, Toronto, ON M4T 1M2. 7/85. 55 pp./28 pp. plastic recycling technology, markets, source separation, Canada.

Hayes, Denis. *Repairs, Reuse, Recycling--First Steps Toward a Sustainable Society.* Worldwatch Paper 23. Washington, DC: Worldwatch Institute, 1978.

Hickman, D. *Designing for Profit in Recycling.* Rowantree Enterprises Box 1613, Stouffville, O LOH 1LO. 1985. 66 pp. Ontario curbside program evaluation.

Horton, Pete. "Waste Management Turns to Recycling Solutions." *Rutland Business Journal.* Volume 5, No. 2. February/March 1988.

Huisingh, Donald et al. *Proven Profits from Pollution Prevention: Case Studies in Resource Conservation and Waste Reduction.* Washington, DC: Institute for Local Self-Reliance, 198 .

Kaplan, E. "Recycling, Not A Lot of Garbage." *Current Health.* 2:12:18-9 December 1985.

Kelley, Kevin J. "Reawakening interest in recycling waste." *Vermont Business Magazine.* November 1988 pp. 12-17.

Kirshner, Dan and Adam C. Stern. *To Burn or Not to Burn, The Economic Advantages of Recycling Over Garbage Incineration for New York City.* New York: Environmental Defense Fund, 1985. $20 ppd.

Mitchell, Adam. *Once Is Not Enough - A Citizen's Recycling Guide.* Boston, MA: National Toxics Campaign, 1988.

Moore, Patricia H. "Success is 45% Recycling," *BIOCYCLE.* May-June, 1987.

New Jersey Office of Recycling. *Steps in Organizing a Municipal Recycling Program.* Trenton, NJ: New Jersey Office of Recycling, 1987. 26 pp., free from NJ Office of Recycling, 401 East State Street, Trenton, NJ 08625.

Pawley, Martin. *Building For Tomorrow: Putting Waste to Work.* San Francisco: Sierra Club Books, 1982. *

Pollock, Cynthia. *Mining Urban Wastes: The Potential For Recycling.* Worldwatch Paper 76. Washington, DC: The Worldwatch Institute, 1987. *

Porter, Richard and Roberts, Tim. *Energy Savings By Wastes Recycling.* London: Elsevier Applied Science Publishers, 1985. (UVM)

Seldman, Neil and Jon Huls. *Waste to Wealth: A Business Guide for Community Recycling Enterprises.* Washington, DC: Institute for Local Self Reliance, 1985. Available for $17.50 from ILSR, 2425 18th Street, NW, Washington, DC 20009.

Shea, Cynthia Pollack. "Building A Market For Recyclables." *World Watch,* May/June 1988. *

Spreading the Word: A Publicity Handbook For Recycling. The Association of New Jersey Environmental Commissions (ANJEC) 300 Mendham Rd., PO Box 157 Mendham, NJ 07945. Anne F. Morris, Executive Director. $8.00

There's More Than One Way To Recycle. 28 pp., $2., Clean Air Council, 311 South Juniper Street, Room 603, Philadelphia, PA 19107. (215) 545-1832. Case studies of eight residential waste recycling programs.

The United States Recycling Movement, 1968 to 1986: A Review. 29 pp., $51.50 Analysis of critical issues facing recyclers and municipal waste managers. New York: Institute for Local Self-Reliance.

Voluntary Source Separation Recycling Projects in Apartment Building Complexes In Southern Ontario. 98 pp., $12. (Canadian) Recycling Council of Ontario, P.O. Box 310, Station P., Toronto, Ontario M5S 2S8, Canada.

Waste Paper - The Future of A Resource: 1980-2000. 245 pages, $25. Washington, DC: American Paper Institute, December 1982.

Marinello, Janet, "Recycling's Little Victories" *Environmental Action.* April 1982. pp. 17-18.

Moore, Dennis. "Recycling: Where Are We Now?" *New Shelter.* February, 1982. pp. 56-69.

Seldman, Neil and Jon Huls. "Beyond the Throwaway Ethic." *Environment.* Volume 23, No. 9, pp. 25-36.

Van Deventer. "Whatever Happened To Recycling?" *Not Man Apart.* January 1983.

Vogler, Jon. "Jobs from Junks: How to Create Employment and Tidy Up Derelict Cars." *Intermediate Technology,* 1983.

Appelhof, Mary. *Worms Eat My Garbage.* Kalamazoo, MI: Flower Press, 1982.*

Compost Toilets: A Guide for Owner Builders. Butte, MT: National Center for Appropriate Technology, 1978.

Composting Information Packet, 1987. Brief brochure on home composting methods. Available for $2.50 plus self-addressed stamped envelope with $.50 postage from Seattle Tilth Association, 4649 Sunnyside Avenue North, Seattle, WA 98103

Foster, Catharine Osgood. *The Organic Gardener.* New York: Alfred A. Knopf, 1972.

Fulford, Bruce. *Research Report On A Composting Greenhouse.* East Falmouth, MA: New Alchemy Institute, 1987.

Hughey, Pat. *Scavengers and Decomposers: The Clean Up Crew.* New York: Atheneum Publishers, 1984. Young audience.

Johnson, Cecil E. "The Wild World of Compost." *National Geographic.* Vol 158, No. 2. August 1980. pp. 272-284.

Kitto, Dick. *Composting: The Cheap and Natural Way to Make Your Garden Grow.*

McLaughlin, Molly. *Earthworms, Dirt and Rotten Leaves: An Exploration in Ecology.* 1986. New York: Macmillan Publishing Co., 1986. Young audience.

Rodale, J. I. ed. *The Complete Book of Composting.* Emmaus, PA: Rodale Press, 1969.

Stoner, Carol. ED. *Goodbye To The Flush Toilet.* Emmaus, PA: Rodale Press, 1977.

Stop the Five-gallon Flush: A Survey of Alternative Waste Disposal Systems. Quebec, Canada: McGill University, School of Architecture, 1976.

Tonge, Peter. "Green Grows Garbage -- 'Convertit process turns municipal trash into fertilizer." *Christian Science Monitor.* March 1988.

Van der Ryne, Sim. *The Toilet Papers.* Santa Barbara, CA: Capra Press, 1978.

Barna, Ed. "Will Vicon Clear The Path For Future Plants?" *Rutland Business*. February 1988.

Environmental Action Foundation, *Fact Packet Resource Recovery*, 1346 Connecticut Ave., NW, Washington, DC 20036 202-296-7570. 8/84. 95 pp. SWM pros and cons-news, mag. papers, clippings.

An Environmental Review of Incineration Technologies. 128 pp., $51.50. New York: Institute for Local Self Reliance, 1986.

The Burning Question: Garbage Incineration vs. Total Recycling in New York City. 188 pp, 1986. $27.50. NYPIRG, 9 Murray St., NY, NY. 10007.

Clarke, Marjorie J. *Emission Control Technologies For Resource Recovery*. New York Department of Sanitation. Presented at Symposium on Environmental Pollution in the Urban Area, Brooklyn Polytechnic University. March 15, 1986.

Hershkowitz, Allen. *Garbage Burning: Lessons from Europe: Consensus and Controversy in Four European States*. INFORM 1986.

Hershkowitz, Allen and Eugene Salerni. *Garbage Management In Japan*. Leading The Way. New York: INFORM, Inc., 1987.

Institute for Local Self Reliance. *Resource Recovery State-of-the-Art: A Data Pool for Local Decision Makers*. New York: Institute for Local Self Reliance, 1986. $36.50.

Kirshner, Dan and Adam C. Stern. *To Burn or Not to Burn: The Economic Advantages of Recycling Over Garbage Incineration for New York City*. New York: Environmental Defense Fund, 1985. $20 ppd.

LeBlanc, Stephen J. *Up In Smoke: Will Massachusetts Gamble On Incineration and Forfeit a Recycling/Composting Future?*, Boston, MA: MASSPIRG., February, 1988.

Garbage: A 413,000 Ton-A-Day Dilemna. Inform Reports 1985 May-June; Vol. 5(3). Inform Inc. 381 Park Avenue South. New York, NY 10016 212-629-4040. 1985. Mass-burn, resource recovery, solid waste.

Hershkowitz, Allen. "Burning Trash: How It Could Work." *Technology Review*. 90:26-34 July 1987.

Monet, Maria P. "Financing Resource Recovery Projects." *Government Finance*. 2:13-17 June 1986.

Marshall, Eliot L. "America's Big Mess: After You Take Out The Trash, Where Will They Put It?" *Governing*. December 1987. pp. 32 ff.

"The Rush To Burn: America's Garbage Gamble." A Special Reprint From *Newsday* and *New York Newsday*. Long Island, New York: Newsday Inc., 1988.

State of Vermont. *Air Pollution Control Regulations*. Effective September 17, 1986. Air Pollution Control Division, Department of Environmental Conservation, Agency of Natural Resources, Waterbury, VT.

Bridgwater, A.V., and K. Lidgren. *Energy in Packaging and Waste.* UK: Van Nostrand Reinhold Co., Ltd., 1983. (UVM)

Budiansky, Stephen. "The World of Crumbling Plastics." *U.S. News and World Report.* November 24, 1986.

Darnay, Arsen and William E. Franklin. *The Role of Packaging In Solid Waste Management 1966 to 1976.* Rockville, Maryland: U.S. Dept. of Health, Education and Welfare, 1969.

De Coninck, Diane. *A Policy Analysis of Fast Food Packaging.* Burlington, VT: Environmental Program, UVM, 1988. Available for $10 postage paid from Environmental Program, UVM, 153 South Prospect Street, Burlington, VT 05743.

Hill, Tom. "Plastics Are Forever." *Upper Valley* (January/February 1989) p. 20.

Klockenbrink, Myra. "Plastics Industry, Under Pressure, Begins to Invest In Recycling." *The New York Times* (August 30, 1988) p. C4.

Packard, Vance. *The Waste Makers.* 1960. discussion of institutionalized waste generation, planned obsolescence.

Pess, George. *Thermoplastics in the Postconsumer Waste Stream.* New York: Environmental Action Coalition, 1985.

Environmental Action Inc. "Wrapped In Plastic" *Environmental Action.* July/August 1988.

Sheets, Kenneth R. "The New High-Tech World of Plastics." *U.S. News and World Report.* February 24, 1986. pp. 52, 53.

Tracy, Eleanor Johnson. "Plastic That Won't Clutter Up The Countryside." *Fortune.* September 1, 1986.

Wehle, D.H.S., and Felicia C. Coleman. "Plastics At Sea" *Natural History.* February, 1983. pp. 21-6.

Weisskopf, Michael. "Plastic reaps a grim harvest in the oceans of the world." *Smithsonian.* March 1988. pp. 58-67.

Wirka, Jeanne. *Wrapped In Plastic: The Environmental Case for Reducing Plastics Packaging.* Washington, DC: Environmental Action Foundation, August 1988.

RESOURCES C.9.1 HOUSEHOLD HAZARDOUS WASTE

Brown, Michael. *Laying Waste: The Poisoning of America by Toxic Chemicals.* New York: Pantheon, 1980.

Boraiko, Allen A. "Storing Up Trouble ... Hazardous Waste." *National Geographic.* Volume 167, No. 3, March 1985.

Dadd, Debra Lynn. *Nontoxic and Natural: How to Avoid Dangerous Everyday Products and Buy or Make Safe Ones.* Los Angeles: Jeremy P. Tarcher, Inc., 1984.

Dadd, Debra Lynn. *The Nontoxic Home: Protecting Yourself and Your Family from Everyday Toxics and Health Hazards.* Los Angeles: Jeremy P. Tarcher, Inc., 1986.

"The Domestic Side of Hazardous Wastes." Air & Land. Vermont Agency of Natural Resources. Winter, 1985.

Environmental Hazards Management Institute. *Household Hazardous Waste Wheel.* Durham, NH: Environmental Hazards Management Institute, 1988. An easy-to-use guide to hazardous house, automotive, pesticide and paint products. Lists hazardous ingredients, hazardous properties, suggested disposal methods and alternatives for 36 chemical products. Available from EHMI, PO Box 932, 10 Newmarket Road, Durham, NH 03824 (603) 868-1496. Available in quantities of 1-99 for $2.75 each. Discounts available for larger orders.

Epstein, Samuel S. MD, et al., *Hazardous Waste In America.* Sierra Club, 1982.

Fossel, Peter. "Sick-Home Blues: The hidden ingredients in modern housing can be enough to make you ill--literally." *Harrowsmith.* September/October 1987. pp. 46-55.

Garland, A.W. and Sinclair, M., "New Ways to Tackle Toxic Wastes" *MS.* 13:135-8. May 1985.

Golden Empire Health Planning Center. *Alternatives to Landfilling Household Hazardous Waste.* Golden Empire Planning Center, 2100 21st Street, Sacramento, CA 95818. (916) 731-5050. Highlights options to landfilling household hazardous waste including reuse, recycling and treatment.

Gordon, Roberta G. "Legal Incentives For Reduction, Reuse and Recycling: a new approach to hazardous waste management." *Yale Law Journal* 95:810-31 March 1986.

Greenfield, Ellen J. *House Dangerous: Indoor Pollution In Your Home and Office--and What You Can Do About It.* New York: Blue Cliff Editions, Inc., 1987.

Lafavore, Michael. "Clean Air Indoors." *Rodale's New Shelter.* 1982. pp.20-28.

League of Women Voters of Albany County. *Household Hazards: A Guide to Detoxifying Your Home.* 1988. 83pg. Guide to identifying toxics and available alternatives. Available for $2.60 postage and handling from the League, 119 Washington Avenue, Albany, NY 12207.

League of Women Voters of Massachusetts. *Household Hazardous Waste Collection Information Kit.* Information and resources on how to set up a collection program. Available for $15 ($10 non-profit) from: League of Women Voters of Massachusetts, 8 Winter Street, Boston, MA 02108 (617) 357-8380. (Make check payable to "Scharfman Fund, LWVM.")

Lord, John. *Hazardous Wastes from Homes.* Santa Monica, CA: Enterprise for Education, 1986. Available from Enterprise for Education, 1320A Santa Monica Mall, Santa Monica, CA 90401 for 2.75 +1.50 p&h. Beautifully designed and illustrated booklet. *

McCann, Michael. *Artists Beware.* New York: Watson-Guptill Publications, 1979.

McCann, Michael. *Health Hazards Manual For Artists.* New York: Nick Lyons Books, 1985.

Melosi, Martin V. "The Cleaning of America." *Environment.* October, 1983, pp. 6-44.

"MOTHER's Guide to Hazardous Household Substances", *The Mother Earth News,* May/June, 1984, pp. 55-64.

"Rumors of Earth's Death are Greatly Exaggerated." *U.S. News And World Report.* May 9, 1983, p. 14.

Postel, Sandra. *Defusing the Toxics Threat: Controlling Pesticides and Industrial Waste.* Worldwatch Paper 79. Washington, DC: Worldwatch Institute, September 1987.

Stark, Norman. *The Formula Book.* Fairway, Kansas: Andrews and McNeel, 1976.

Toteff, Sally and Cheri Zehner. *Toward Hazardless Waste. A Guide For Safe Use and Disposal of Hazardous Household Products.* September 1985. Available from Metro, M.S.81, 821 Second Avenue, Seattle, WA 98104. 20-page booklet.

Vermont Public Interest Research Group. "Schools May Be Using Toxic Art Supplies." *VPIRG Update.* Spring 1988. VPIRG, Montpelier, VT Spring 1988. pp. 1,2.

Wallace, Dan, Ed. *The Natural Formula Book for Home and Yard.* Emmaus, PA: Rodale Press, 1982.

Water Pollution Control Federation. *Hazardous Waste - What You Should and Shouldn't Do.* Alexandria, VA: Water Pollution Control Federation, 1987. Available from Water Pollution Control Federation, 601 Wythe St., Alexandria, VA 22314-1994. Colorful pamphlet with household hazardous waste disposal chart.

Zamm, Alfred E. *Why Your House May Endanger Your Health.* New York: Simon & Schuster, 1980.

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